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PROCEEDINGS

OF THE

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

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VOLUME XI.–1884-85.

EDITED BY

THOMAS COLE,

ASSOC. M. INST. C.E.

(*Secretary of the Association*).

The Association is not as a body responsible for the facts and opinions advanced herein.

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ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

LIST OF OFFICERS, 1885–6.

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Royle, H., Assoc. M. Inst. C.E.	Surveyor to the Local Board, Stretford, Lancashire.

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Shuttleworth, F. H.	Surveyor to the Local Board, Littleborough, Lancashire.
Simpson, John, jun.	Surveyor to the Local Board, Matlock.
Smith, G. F.	Surveyor to the Local Board, Milverton, Warwickshire.
Smith, H. O.	Late Engineer to the Commissioners, Chiswick, Middlesex.
Smith, J. W. M.	Borough Surveyor, Wrexham, Denbighshire.
Spencer, J. P., Assoc. M. Inst. C.E.	50, Side, Newcastle-on-Tyne.
Spinks, W., Assoc. M. Inst. C.E.	Surveyor to the Local Board, Dukinfield.
Stafford, J. E., Assoc. M. Inst. C.E.	Borough Engineer, Burnley.
Stainthorpe, T. W.	Surveyor to the Eston District Local Board.
Stewart, Wm.	Surveyor to the Local Board, Rugby.
Strachan, G. R.	Surveyor, Chelsea.
Stringfellow, H. W.	Late Surveyor to the Local Board, Sheerness.
Stubbs, Wm., Assoc. M. Inst. C.E.	Borough Surveyor, Over Darwen.
Swarbrick, Joseph, Assoc. M. Inst. C.E.	Surveyor to the Local Board, Withington, near Manchester.
Sykes, Ed.	Surveyor to the Local Board, Reddish.

Taylor, H.	Surveyor to the Local Board, Clevedon, Somerset.
Taylor, J. H., Assoc. M. Inst. C.E.	Borough Surveyor, Barnsley.
Thomas, John	Surveyor to the Rural Sanitary Authority, Swansea.
Thomas, W., Assoc. M. Inst. C.E.	Borough Surveyor, Dorchester.
Thompson, R.	Surveyor to the Local Board, Waterloo, near Liverpool.
Thoms, G. E., M. Inst. C.E.	Borough Engineer, Wolverhampton.
Thomson, P. W. (*Member of Council.*)	Surveyor to the Local Boards of Willington Quay and Wallsend, Northumberland; *Hon. Secretary*, Northern District.
Thorburn, T. C.	Borough Surveyor, Birkenhead.
Thorrold, S. E.	Surveyor to the Local Board, South Stockton.
TILL, W. S., M. Inst. C.E. (*Past President.*)	Borough Engineer, Birmingham.
Tomes, C.	Borough Surveyor, Eastbourne.
Trapp, S. C.	88, Mosley Street, Manchester.
Tudor, E. C. B.	Surveyor to the Local Board, Goole, Yorkshire.
VAWSER, R., M. Inst. C.E. (*President.*)	17, Cooper Street, Manchester.
Veevers, H., Assoc. M.I.C.E.	Late Surveyor to the Local Board, Dukinfield.
Walker, T., Assoc. M. Inst. C.E. (*Member of Council.*)	Borough Surveyor, Croydon, Surrey.
Wallis, T. W.	Borough Surveyor, Louth.
Webster, J. L.	Borough Surveyor, Malton.
Welburn, W.	Surveyor to the Middleton and Tonge Improvement Commissioners, Middleton near Manchester.
Wheeler, W. H., M. Inst. C.E.	Borough Surveyor, Boston, Lincolnshire.
WHITE, W. H., M. Inst. C.E. (*Past President.*)	Engineer to the Local Board, Oxford.
Whitlow, Henry	Surveyor to the Local Board, Sowerby Bridge.
Whittington, W.	Borough Surveyor, Neath.
Wilds, W. H.	Borough Engineer, Hertford.
Wilkinson, J. P.	Surveyor to the Local Board, Newton Heath, near Manchester.
Willcox, J. E., Assoc. M. Inst. C.E	Surveyor to the Aston Rural Sanitary Authority.
Wilson, J. B.	Surveyor to the Local Board, Arlecdon and Frizington, Cumberland.
Wilson, J.	Surveyor to the Local Board, Bacup, Lancashire.
Wilson, William	Surveyor to the District Local Board, Dalton-in-Furness.
Winship, G., Assoc. M.I.C.E.	Borough Surveyor, Abingdon, Berks.
Witts, J. W.	Town Surveyor, Skelton in Cleveland.
Wood, A. R.	Surveyor to the Local Board, Tunstall.
Worswick, R. A.	Surveyor to the Local Board, Whitley, Newcastle-on-Tyne.
Wright, J.	Borough Surveyor, Macclesfield, Cheshire.

TOWNS AND DISTRICTS REPRESENTED BY MEMBERS OF THE ASSOCIATION.

Abergavenny	Jon. Haigh.
Abingdon	G. Winship.
Accrington	E. Knowles.
Aldershot	W. L. Coulson.
Alton	J. Barlow.
Arlecdon	J. B. Wilson.
Ashton-under-Lyne	J. T. Earnshaw.
Aston Manor	W. A. Davies.
(Rural)	J. E. Willcox.
Audenshaw	J. H. Burton.
Bacup	J. Wilson.
Barking	C. J. Dawson.
Barnsley	J. H. Taylor.
Barrow-in-Furness	W. H. Fox.
Barton-upon-Irwell (Rural)	C. C. Hooley.
Barton, Eccles, Winton, and Monton	T. Heywood.
Batley	J. W. Horsfield.
Beckenham	G. B. Carlton.
Bedford	J. Lund.
Benwell	T. Dawson.
Beverley	J. Beaumont.
Bingley	R. Armistead.
Birkenhead	T. C. Thorburn.
Birmingham	W. S. Till.
,,	E. Pritchard.
Blackburn	J. B. McCallum.
Blackpool	T. Sunderland.
Blaydon-on-Tyne	M. Hawdon.
Bognor	W. L. Barret.
Bolton	J. Proctor.
Boston	W. H. Wheeler.
Bournemouth	G. R. Andrews.
Bowdon	J. Newton.
Bradford	J. H. Cox.
Brecknock	R. Davies.
Brentford	F. W. Lacy.
Bridgewater	G. B. Laffan.
Bridlington	S. Dyer.
Brighton	P. C. Lockwood.
Bristol	F. Ashmead.
Briton Ferry	H. F. Clarke.
Bromley	H. S. Cregeen.
Burnley	J. E. Stafford.
Burton-upon-Trent	E. Clavey.
Bury	J. Cartwright.
,,	J. Farrar.
Buxton	J. Hague.

Canterbury	J. G. Hall.
Carlisle	H. U. McKie.
Cheltenham	G. W. Sadler.
Cheshunt	T. Bennett.
Chester	I. M. Jones.
Chesterfield	W F. Howard.
Chesterton	D. Bland.
Chiswick	A. Ramsden.
Clevedon, Somerset	H. Taylor.
Colchester	C. Clegg.
Compton Gifford	J. C. Inglis.
Coventry	E. J. Purnell.
Crewe	G. Eaton.
Crompton	J. Mawson.
Croydon	T. Walker.
„ (Rural)	R. M. Chart.

Dalton-in-Furness	William Wilson.
Derby	Thos. Coulthurst.
Dorchester	W. Thomas.
Dorking	G. S. Mathews.
Dover	M. Curry.
Dudley	J. Gammage.
Dukinfield	W. Spinks.
„	H. Veevers.

Ealing	C. Jones.
Eastbourne	C. Tomes.
East Ham	W. H. Savage.
Epsom	J. R. Harding.
Eston District	T. W. Stainthorpe.

Fenton	S. A. Goodall.
Finchley	G. W. Brumell.
Fleetwood	M. S. Gaulter.

Gateshead-on-Tyne	J. Bower.
Gloucester	R. Read.
Goole, Yorkshire	E. C. B. Tudor.
Grantham, Lincolnshire	S. G. Gamble.
Great Crossby	I. Dixon.
Great Grimsby	J. Buchan.
„ „	J. Maughan
Great Yarmouth	J. W. Cockrill.

Halifax	E. R. S. Escott.
Hanley	J. Lobley.
Harborne	W. Newey.
Harwich	H. Ditcham.
Heckmondwike	T. Gledhill.
Hereford	J. Parker.
Hertford	W. H. Wilds.
Heston and Isleworth	W. B. Bromley.
Hexham	R. Grieves.
Heywood	J. Diggle.
Hornsey	T. De C. Meade.
Hove	E. B. Ellice-Clark.
Hull	J. Fox Sharp.
Huntingdon	R. Hutchinson.
Hurst Brook	J. Heys.
Hyde	J. Mitchell.

Ipswich	E. Buckham.
Jarrow	J. Petree.
Kidderminster	A. Comber.
King's Lynn	E. G. Mawbey.
King's Norton	R. Godfrey.
Kirkleatham	J. Howcroft.
Lancaster	A. Creer.
Leeds	T. Hewson.
Leicester	J. Gordon.
Lewes	A. Holt.
Leyton, E.	W. Dawson.
Lincoln	R. A. MacBrair.
Littleborough	F. H. Shuttleworth.
Liverpool	C. Dunscombe.
„	G. F. Deacon.
„	G. Biddle.
Llandudno	T. T. Marks.
Longton	A. Hardwicke.
Louth	T. W. Wallis.
Lowestoft	R. H. Inch.
Luton, Bedfordshire	W. H. Leete.
Macclesfield	J. Wright.
„	H. S. Aspinwall.
Maidstone	F. J. C. May.
„ (Rural)	E. P. Hooley.
Malton	J. L. Webster.
Manchester	J. Allison.
„	S. C. Trapp.
„	R. Vawser.
Matlock	J. Simpson, jun.
Melton Mowbray	E. Jeeves.
Merthyr Tydfil	S. Harpur.
Middlesbrough	E. D. Latham.
Middleton (Lancashire)	W. Welburn.
Milverton	G. F. Smith.
Morpeth	T. W. Middlemiss.
Neath	W. Whittington.
Nelson-in-Marsden	W. Dent.
Neston	J. Morris.
Newark	Geo. Sheppard.
Newcastle-on-Tyne	W. G. Laws.
„	J. P. Spencer.
Newcastle-under-Lyme	J. Pattison, jun.
Newton Heath	J. P. Wilkinson.
Newton-in-Makerfield	R. Brierley.
North Bierley	J. Cook.
Nottingham	A. Brown.
Over Darwen	W. Stubbs.
Oxford	W. H. White.
Pemberton	Geo. Heaton.
Plymouth	R. Hodge.
Portsmouth	H. P. Boulnois.
Prescot	W. Goldsworth.

Ramsgate	W. C. Barley.
Reading	A. W. Parry.
Reddish	E. Sykes.
Redditch	T. W. Baylis.
Reigate	J. H. C. B. Hornibrook.
Rhyl	Robt. Hughes.
Richmond	W. Brooke.
Rochdale	S. S. Platt.
Rochester	W. Banks.
Rotherham	G. Jennings.
Rugby	W. Stewart.
Ryde	F. Newman.

Sale	A. G. McBeath.
Sevenoaks	J. Mann.
Sheffield	R. Davidson.
Shepton Mallet	J. Bourne.
Shrewsbury	G. J. Butler.
Skelton in Cleveland	J. W. Witts.
Sleaford	Jesse Clare.
Southampton	J. Lemon.
Southgate	C. G. Lawson.
Southport	W. Crabtree.
South Hornsey	Ed. Fry.
South Shields	M. Hall.
South Stockton	S. E. Thorrold.
Sowerby Bridge	H. Whitlow.
Stafford	W. Blackshaw.
Stamford	Jas. Richardson.
Stockport	A. M. Fowler.
Stockton-on-Tees	J. Hall.
Stoke-on-Trent	W. Bowen.
Stourbridge	W. Perry.
Stratford-on-Avon	A. T. Davis.
„ „	T. T. Allen.
Stretford	H. Royle.
Stroud	J. P. Lofthouse.
St. Thomas, near Exeter	S. Churchward.
Sunderland	R. S. Rounthwaite.
Swansea (Rural)	J. Thomas.
Swinton, Yorkshire	J. C. Haller.
Swinton and Pendlebury, Lancashire	A. H. Mountain.

Tewkesbury, Gloucestershire	W. H. Gray.
Tipton	S. F. Rowley.
Tiverton, Devon	Wm. Rowe.
Todmorden	A. Greenwood.
Tonbridge	W. Noot.
Torquay	Joseph Hall.
Toxteth Park	J. Price.
Tranmere	W. A. Richardson.
Tunstall	A. R. Wood.
Turton	Jas. Parkinson.
Tynemouth	C. T. Gomoszynski.

Ventnor	R. S. Scott.
„	J. G. Livesay.

Wakefield	R. Porter.
Walsoken	J. Kerridge.
Walthamstow	G. B. Jerram.
Walton on the Hill	S. Middlebrook.
Wanstead	J. T. Bressey.
Warminster	T. Cruse.
Warwick	E. M. Richards.
Waterloo, Liverpool	R. Thompson.
Watford	C. C. Lovejoy.
Wellingborough	E. Sharman.
West Bromwich, Staffordshire	J. T. Eayrs.
West Derby, Liverpool	E. H. Allies.
West Ham, London	L. Angell.
West Hartlepool	J. W. Brown.
Weymouth and Melcombe Regis	W. B. Morgan.
Whitehaven	R. Pickering.
Whitley	R. A. Worswick.
Whitworth	Thos. Holt.
Willesden	O. C. Robson.
Willington Quay, Northumberland	P. W. Thomson.
Wimbledon	W. Santo Crimp.
Windsor	T. V. H. Davison.
Withington	J. Swarbrick.
Wolverhampton	G. E. Thoms.
Woodford	J. D. Hooper.
Worksop	J. Allsopp.
Wrexham	J. W. M. Smith.
	A. S. Jones.
York (Rural)	W. G. Penty.

RULES OF THE ASSOCIATION.

I.—That the Society be named the "ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS."

II.—That the objects of the Association be—

a. The promotion and interchange among its Members of that species of knowledge and practice which falls within the department of an Engineer or Surveyor engaged in the discharge of the duties imposed by the Public Health, Local Government, and other Sanitary Acts.

b. The promotion of the professional interests of the Members.

c. The general promotion of the objects of Sanitary Science.

III.—That the Association consist of Civil Engineers and Surveyors holding chief permanent appointments under the various Municipal Corporations or Sanitary Authorities within the control of the Local Government Board. Each Candidate for Membership shall be proposed by at least two Members, who from personal knowledge of such Candidate shall certify that he possesses the necessary qualification. Members who cease to hold their appointments are eligible for re-election by the Council, but will be disqualified from holding any office. Civil Engineers and Surveyors holding similar appointments in Scotland or Ireland, in the Colonies or Foreign Countries, shall be eligible for election as Members, subject to the approval of the Council. The Council shall also have power to elect such Honorary Members as they may see fit.

IV.—That the Affairs of the Association be governed by a Council, consisting of a President, Three Vice-Presidents, Twelve Members, and an Honorary Secretary, to be elected annually. The Past Presidents and the District Secretaries for the time being shall also be Members of the Council.

V.—That the Council shall nominate one name for President, six for Vice-Presidents, one for Hon. Secretary, and fifteen for Ordinary Members of council. In addition to these each Member of the Association shall be at liberty to nominate one Member for the Council, but in the event of the last-named Nominations exceeding fifteen, the Council shall reduce them to that number, so as to leave thirty names in all from which to elect the required number of Ordinary Members of Council. Members' Nominations must be in the hands of the Secretary on or before the 20th of April in each year. Such list of thirty Nominations shall be printed and sent to each Member of the Association not less than fourteen days previous to the Annual Meeting. Every Member shall be entitled to vote for or erase any of such Nominations, or substitute other names, subject in all cases to the limits of Rule IV., and return the same within seven days from the date of issue. Such ballot papers shall be examined in London by the President, Secretaries, and two Scrutineers appointed at the previous Annual Meeting, or by any two of the aforesaid Members. Any Member canvassing for votes for the office of Member of Council shall be considered ineligible for election.

VI.—That the Association be formed into District Committees which shall include the whole of the Members. Such Committees shall meet from time to time, in convenient centres, for the discussion of matters of local and general interest connected with the Association. Each District Committee shall appoint a District Secretary, who will keep records of local proceedings, and communicate with the Council. All District Secretaries shall vacate their office at the Annual Meeting, and Members shall then be appointed to act as Local Secretaries until a District Meeting can be arranged, at which Meeting a District Secretary shall be appointed.

VII.—That a General Meeting and Conference of the Association shall be held annually in such towns, in rotation, as may afford convenient centres for assembling the Members.

VIII.—That an entrance-fee of One Guinea, and a subscription of One Guinea per annum, from Civil Engineers and Surveyors under Rule III., shall constitute Membership of the Association.

IX.—That no new Rule or alteration of any existing Rule be made unless Notice of Motion for such purpose and the proposed Resolution thereon be sent to the Secretary by the 31st of March, and such Notice of Motion and Resolution shall be printed in the Agenda for the ensuing Annual Meeting.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

TWELFTH ANNUAL MEETING.

London, *June* 25*th*, 26*th*, *and* 27*th*, 1885.

GENERAL BUSINESS.

The Members assembled in the Theatre of the Institution of Civil Engineers, Great George Street, Westminster, when Mr. W. G. Laws, President, took the chair, and the Minutes of the Annual Meeting, held in Newcastle in July 1884, were read, confirmed, and signed.

The Secretary then read the Annual Report and Statement of Accounts for the year ending April 30th, 1885.

ANNUAL REPORT.

In this Report, which the Council have the pleasure to submit to the Members, on the proceedings of the last year, and on the position attained by the Association, it will be found that the steady progress which has been a subject for congratulation by successive Councils shows no sign of diminution.

Since the last General Meeting held in Newcastle on the 10th of July, 1884, in accordance with the Association's Rule, District Meetings have been held in convenient centres for the discussion of matters "of local and general interest connected with the Association." Eight of these meetings have been held during the past year. In London on the 9th of October, 1884; at Leyton on the 10th of October; at Stockton-on-Tees on the 18th of October; at Torquay on the 25th of October; at Colchester on the 25th of October; at Leeds on the 8th of November; at Burnley on the 25th of April, 1885, and at Nottingham on the 16th of May.

Besides these meetings, a Supplementary Meeting, in the Lancashire and Cheshire District, was held at Crewe on the 22nd of November, 1884. While more or less considerable interest contributed to the success of all these meetings, special mention may be recorded in the case of the London meeting which was held at the Health Exhibition, and which was presided over by the Right Hon. Sir Charles Dilke, M.P., the President of the Local Government Board, and attended by some of the most eminent sanitarians of the day.

The Council have to announce that forty new Members have joined the Association during the past year, seven Members have resigned, six Members have been written off; and regret to have to report the deaths of Mr. L. Dewey, of Cheshunt, and Mr. J. H. Pidcock, of Northampton, and of the late Secretary, Mr. Graham Smith.

The number on the roll of the Association at the close of the year was, 6 Honorary Members, 236 Ordinary Members, making 242 in all. The Council request that every Member will make individual endeavour to increase this total by inducing their brother officers who have not already joined, to become Members, as the importance and efficiency of the Association will manifestly increase with its strength.

The accompanying duly audited Balance Sheet of the financial year bears out the satisfactory state of the Association, showing a balance in hand of 127*l.* 17*s.* 5*d.* The statement of assets and liabilities also goes to show the sound financial position of the Association.

The Ballot lists were issued in accordance with the Rules of the Association, and the Scrutineers have reported the following gentlemen elected to the Council:—

President.—R. Vawser.

Vice-Presidents.—C. Dunscombe, J. Gordon, J. Lobley.

Ordinary Members of Council.—J. Allison, H. P. Boulnois, J. Cartwright, T. Coulthurst, R. Davidson, E. B. Ellice-Clark, T. Hewson, P. C. Lockwood, H. U. McKie, T. De C. Meade, A. W. Parry, and T. Walker.

General Honorary Secretary.—C. Jones.

Treasurer.—L. Angell.

In compliance with a Resolution passed at the last General Meeting, the Council have obtained from the Members such views and suggestions as the Members were desirous of embodying in the

Memorial to the President of the Local Government Board that was presented at that last Annual Meeting. These suggestions and views having been carefully considered, such of them as were considered necessary were embodied in the Memorial, which lies drafted and awaits the termination of the Ministerial crisis and the appointment of the President of the Local Government Board.

The Council have given serious consideration as to the advisability of applying for a Royal Charter to give additional prestige and position to the Association. After much deliberation, however, it has been thought that the present moment is inopportune for the Council to advise undertaking the large expense such a step would incur, but under the circumstances in its place they advise the Association to become a registered body under the Scientific and Literary Institutions Act or the Companies Act, and the Council asks the meeting to authorise the necessary steps being taken for such registration. In these considerations one important object that the Council have in view is the desirability of this Association taking upon itself, as the most fitting body for such a purpose, the institution of voluntary examinations and the granting of certificates of competency to candidates for the appointments of borough surveyors and surveyors to local boards and other sanitary authorities, and with the assent of the present annual meeting the Council propose to mature and issue a scheme for such examination, to take effect at as early a date as practicable.

The Council have, in accordance with the decision come to at the last General Meeting, reconsidered the Rules of the Association as they at present stand, and had a conference with Messrs. De Courcy Meade, Jerram and Newman, appointed for that purpose at that meeting, held at Newcastle in July last year, and in the result agreed with those gentlemen to submit certain alterations to these Rules, which have, in accordance with the same minute, been circulated and sent to every Member of the Association.

In consequence of frequent inquiries for the earlier volumes of the 'Proceedings,' now unfortunately out of print, the Council tested the requirements of the Members in respect to this matter, and it was found that for the present at least the demand would not justify the expense of reprinting.

The Council recommend that the next Annual Meeting be held at Hanley.

The President moved and Mr. Laws seconded the adoption of the Report. This was carried and the Ballot papers ordered to be destroyed.

A discussion then took place upon the Rules, which were taken seriatim.

Nos. I. and II. were adopted without comment.

With respect to Rule III., Mr. Strachan moved and Mr. Ellice-Clark seconded, that the question of admitting, as full Members of the Association, surveyors holding chief appointments under vestries and district boards of the Metropolis be referred to the Council for consideration. The proposition was carried and Rule III. was adopted.

Rule IV. was formally adopted.

Rule V. was adopted with the emendation moved by Mr. Godfrey and seconded by Mr. Strachan that the words "such list of thirty nominations" be substituted for "the full list of nominations," and that the omission of all the words relating to erasing nominations and substituting other names after the list of thirty candidates had been settled, be further considered by the Council.

Rules VI., VII., VIII., and IX. were formally adopted.

Mr. Parry, of Reading, and Mr. Gamble, of Grantham, were elected Auditors for the ensuing year.

Mr. Dawson (Leyton), Mr. Jerram (Walthamstow), Mr. Spencer (Newcastle-on-Tyne), and Mr. Holt (Lewes), were appointed Scrutineers for the ensuing year.

The following gentlemen were appointed to act as District Secretaries:—

Mr. O. C. Robson, Willesden	*Home Counties District.*
Mr. E. Buckham, Ipswich	*Eastern* „ „
Mr. E. Pritchard, Birmingham ..	*Midland* „ „
Mr. Jos. Hall, Torquay	*Western* „ „
Mr. J. W. Horsfield, Batley	*Yorkshire District*
Mr. S. S. Platt, Rochdale	*Lancashire and Cheshire District.*
Mr. P. W. Thomson, Willington Quay	*Northern Counties District.*

Mr. Laws then vacated the chair.

Mr. R. Vawser, having taken the Presidential chair, briefly acknowledged the honour conferred upon him as the highest compliment the Association could pay a Member, and trusted, when his term of office was finished, the Association would have no cause to regret their selection.

Mr. CHAS. JONES, in proposing a vote of thanks to the retiring President, said that he could not recall to mind any previous occupant of the chair who had exceeded the interest which had been shown in the Association during the past twelve months by Mr. Laws. The Members had learned to esteem him very highly, and he was sure that one and all, both those who were absent as well as those present, would endorse what he said when he hoped that Mr. Laws would live long amongst them and the Association would long experience that characteristic urbanity and kindness all had enjoyed ever since Mr. Laws first took the chair.

Mr. McKIE, in seconding the proposition, spoke of his personal acquaintance with Mr. Laws, and warmly endorsed the proposer's remarks. He felt sure that all would agree that Mr. Laws had fulfilled his year of office with honour to himself and with advantage to the interests of the Association. The proposition was carried with acclamation.

The PRESIDENT then read his inaugural address.*

CHAS. JONES, *Hon. Sec.*
THOMAS COLE, *Secretary.*

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* This address, and the papers read at the Meeting, will be found at the end of the volume.

Dr. STATEMENT OF RECEIPTS AND EXPENDITURE FOR THE YEAR ENDING APRIL 30TH, 1885. Cr.

RECEIPTS.	£	s.	d.
To Balance at Bank (May 1st, 1884)	119	3	10
„ Entrance Fees	42	0	0
„ Subscriptions	205	16	0
„ Arrears	14	14	0
„ Publishers' Sale of Proceedings	15	16	9
„ Balance of Petty Cash due to Secretary	2	1	4
	£399	11	11

EXPENDITURE.	£	s.	d.
By Carlisle and South Shields Meetings	5	0	0
„ Leicester Meeting	4	10	8
„ Ealing Meeting	2	16	4
„ Annual „ (Reporter)	10	10	0
„ Home District (Healtheries) Meeting	3	3	0
„ Leeds Meeting	3	3	0
„ Colchester Meeting	6	18	0
„ J. Swain, Litho's	3	16	0
„ Messrs. Clowes (Printing vol. x.)	128	2	0
„ Messrs. Cook and Hammond (Sundry Printing) ..	16	14	0
„ Secretary's Salary	60	0	0
„ Petty Cash—Stationery and Sundries	8	1	3
Postages, vol. x.	5	6	0
„ General	6	13	6
„ Circulars	7	0	7
„ Draft Stamps charged by Bank	0	0	2
„ Balance at Bank, 30th April, 1885	127	17	5
	£399	11	11

STATEMENT OF ASSETS AND LIABILITIES, APRIL 30TH, 1885.

LIABILITIES.	£	s.	d.
To Estimated Liability on vol. xi.	30	0	0
„ Sundry Printing	5	0	0
„ Outstanding Accounts	0	0	0
„ Sundry Expenses, Ealing Meeting	5	10	6
„ Balance, Petty Cash due to Secretary	2	1	4
„ Balance	169	17	1
	£212	8	11

ASSETS.				£	s.	d.
By Balance at Bank				127	17	5
„ Subscriptions in Arrear	£81	18	0			
„ „ less 50 per cent. bad ..	40	19	0—	40	19	0
„ Proceedings in Stock	£87	5	0			
„ „ less 50 per cent.	43	12	6—	43	12	6
				£212	8	11

Examined and found correct, Albert W. Parry, } Auditors.
Sidney G. Gamble, }

May 25th, 1885.

Lewis Angell, *Treasurer*.
Chas. Jones, *Hon. Secretary*.
Thomas Cole, *Secretary*.

DISTRICT MEETING AT LONDON.

October 9th, 1884.

Held in the Jury Room at the Health Exhibition, South Kensington.

Mr. W. G. Laws, *President, in the Chair.*

Mr. O. C. Robson was unanimously re-elected Hon. Sec. for the Home Counties District.

Sir Chas. Dilke, Bart., M.P., President of the Local Government Board, then took the chair.

Mr. Laws, addressing Sir Charles Dilke, expressed on behalf of the Association the pleasure they felt at having in the chair, and joining them in their deliberations, a gentleman who from his position at the head of the Local Government Board they naturally looked to as their chief; and a gentleman who from the interest he had shown in sanitary matters they would be glad to welcome there in any capacity.

Sir Charles Dilke having briefly replied, the following papers were read and discussed:—

THE ORIGIN, CONSTITUTION, AND OBJECTS OF THE ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

By LEWIS ANGELL, M. Inst. C.E., F.R.I.B.A.,
Past President.

It has been thought suitable at this meeting of our Association, on an occasion so unique as within an International Health Exhibition, honoured with the presence and under the Presidency of the Minister of Health, that some account should be given of the origin, constitution, and objects of our Association, and, as one of its founders and first President, I have been requested to undertake the work.

First, then, our Association is identified in the most practical way with the objects of this Exhibition, being composed exclusively of the Municipal, Borough and Local Board Engineers and Surveyors, who are the executive sanitary officers of the country. Each Member represents a city, town or sanitary authority, and we have nearly 300 such Members, representing as many sanitary authorities. We were called into existence, as sanitary officers, under the General Board of Health in 1848. Previously to that time engineering knowledge and sanitary science were not necessary qualifications for a town surveyor. Sanitary science was in its infancy, accepted and taught only by a small but earnest band whose ideas were regarded as impracticable, fussy and Utopian. Among these were Edwin Chadwick and Robert Rawlinson, whom we may congratulate on having lived to see the outcome of their labours in the universal recognition of sanitary principles as exemplified in this Exhibition.

The Public Health Legislation of 1848 was added to year by year, until in 1869 it was found necessary to consolidate the multifarious and confused sanitary laws which had accumulated during the previous 21 years. A Royal Commission was appointed "to inquire into and report on the operation of the sanitary laws in England and Wales." Much evidence was taken from mayors, town clerks, medical officers and others, but of our class, the borough and town surveyors, the executive officers having practical experience in the details, the operation and the defects of such laws, not one was called upon to give any evidence, or invited to offer any suggestion. Our very existence was ignored. The omission was so strange, and the reason, or absence of reason, so inexplicable, as to induce me to communicate with the Royal Commission and the Home Secretary upon various points. Although the evidence was then closed and the Report agreed to, I was invited by the late Mr. Tom Taylor, Secretary of the Local Government Act Office, to offer suggestions, and informed that the suggestions so offered had been considered and were "such as might very properly be submitted by the Secretary of State, on behalf of the Surveyors, to the Minister or Department charged with the preparation of any Bill for carrying out the recommendation of the Sanitary Commission." Although so far this was satisfactory, the obvious weakness of the position was that in thus corresponding with great public departments I represented nobody; hence the necessity for our Association. On March 11th, 1871, a meeting was held in the Town Hall of West Ham, attended by only five officers; other meetings followed, and on May 2nd, 1873, the inaugural meeting of the Association was held in London at the Institution of Civil Engineers, since which time we have numbered among our Presidents the Municipal Engineers of Liverpool, Manchester, Birmingham, Leeds, Bristol, Newcastle, Southampton, Oxford, and other important centres of population. We have discussed every form of municipal sanitary question; we have issued an annual volume of 'Proceedings'; we have inspected every important sanitary work; we have held meetings in almost every large and in many of the smaller towns; we have been received and entertained by the great corporations; and this day we have met in the first International Health Exhibition, under the presidency of a Cabinet Minister. Our Association therefore stands before the world with a history, and our office has obtained a recognition to which we were strangers in the days of the Royal Sanitary Commission.

Such, briefly, is our history and our constitution.

Under Rule II. our objects are thus defined:—

(*a*) The promotion and interchange among its Members of that species of knowledge and practice which falls within the department of an Engineer or Surveyor engaged in the discharge of the duties imposed by Public Health and other Sanitary Acts.

(*b*) The promotion of the general interests of the Members.

(*c*) The general promotion of the objects of sanitary science.

Such, then, are our objects, promoted by constant meetings, discussions, and the interchange of views and experience in all parts of the country.

Whenever there is an epidemic or cholera scare it is the fashion of people, utterly careless at other times as to their local institutions and representatives, to launch out into hysterical denunciations of local management, and as a corporation has neither a conscience to appeal to nor a body to be kicked, the local officer supplies the *corpus vili.* Only last week a letter in the *Times* flippantly accuses sanitary officers of incompetency. Of course incompetent people are to be found in every department of local or Imperial government, and if local authorities offer only insignificant inducements, of course they can expect only corresponding services. Our present object is not the defence of local authorities, but, if such be needed, of their officers. The existence of this Association is a proof that the official sanitary engineers of the country are not only fully alive to their duties, but willing and anxious to discharge them, without the assistance of newly-fledged sanitary writers in the daily press, some of whom, too obviously, are only touting for a new field of employment. Such inefficiency as exists is, we submit, not due to local officers, but to the insufficiency of staff, the insufficiency of power, and, not infrequently, to the supineness, or even the obstructiveness, of the local authority itself, to which must be added the difficulty of enforcing the law and obtaining convictions. We know, from experience, the ease with which a jerry builder and sharp lawyer can drive the proverbial coach-and-four through an Act of Parliament upon technical points and by false evidence. For instance, in a case of unquestionably bad mortar, in which I was present but not interested, the local surveyor stood alone in his evidence; the defendant, of course, brought half-a-dozen so-called surveyors and "practical" men to swear to the contrary, and the Justices decided against the official because the *balance* of evidence was against him; that is, the surveyor was in a minority of one, while a well-known jerry builder was supported by half-a-dozen satellites.

The Press has recently been rather full of complaints, and justly so, of the insanitary arrangements of house drainage, water fittings, &c., vital matters which unquestionably should be under the complete supervision and control of the local sanitary officers. Until quite recently we know that no one looked after these things, their importance was not appreciated. The homes of the million have no architect, and even where an architect was employed, sinks and drains were not sufficiently æsthetic subjects for his attention, they were even beneath the notice of the foreman. Drains are left to ignorant labourers who maul and chop and twist the pipes about after their own fashion, in such manner as to provide every possible facility for the escape of sewage, foul gases and vermin—the new Government offices at Whitehall to wit. But where, it is asked, is the local surveyor? I will tell you where he is. He is attending to the hundred-and-one details of his office, writing reports, correspondence, making estimates, keeping accounts, looking after his contracts, road and paving works and the like, assisted perhaps by his staff of one boy, grudgingly allowed by the local sanitary authority, pledged to their constituents to keep down the rates. In addition to all other routine and special duties, how is it possible that the hundreds of houses which are run up in populous places, especially in the suburbs of the metropolis, can be supervised without supervisors? The local surveyor is expected to be everyone's architect. Staff means salaries, salaries mean rates, and members are pledged to keep down rates; they do not keep down dirt, disease, and jerry buildings, but salaries. But why should salaries come out of rates? For many years past in the Metropolis and in Bristol, building surveyors have been paid out of fees, that is to say, those who impose the work, builders or their clients, pay for it. The proposal to extend the Metropolitan and Bristol system to the Public Health Act has been put before the authorities at Whitehall on several occasions. Twenty years ago, with several other municipal surveyors, I signed a memorial on this subject to the Home Secretary, then the chief of our department. Subsequently the West Ham Local Board, whom I have the honour to serve, memorialised the Local Government Board upon the matter, but the Local Government Board have either not had the time or the inclination to attend to the subject; indeed, it is understood that the permanent officials at Whitehall object to fees on the ground that all necessary supervision is a municipal obligation, and should be paid out of rates. The practical answer is that supervision is not so provided, and insanitary houses grow apace.

It cannot be said that fees are a new institution in this country, most people are, at least, accustomed to them, and in the case in question their imposition would appear to be perfectly equitable, inasmuch as building societies and speculators working in their own interests, and frequently making large profits, impose the necessity for an increased local staff to supervise their works; why, therefore, should not the local authority be able to impose on them a fee, small on each building, but sufficient in the aggregate, to pay for such supervision? In 1879, ducal Eastbourne, by a private Act, obtained the powers which West Ham had sought through the Local Government Board. West Ham, wherein between 2000 and 3000 houses are erected annually, following the example of Eastbourne, also applied for a private Act; the Bill was unopposed, and a Committee of the House of Commons ready to assent, but we had reckoned without our host, the Chairman of Committees of the Lords, ruthlessly, in his own office, cut out our clauses, on the ground that local authorities should not have powers outside the Public Health Act. We quoted Eastbourne. Lord Redesdale replied that there were exceptional circumstances there—the only discoverable circumstances are that Eastbourne is the property of the Duke of Devonshire. We lost that portion of our Bill, and the jerry builders continued to have a good time, so good, indeed, that the following year we again went to Parliament, and assumed such an attitude that even my Lord Redesdale, after many interviews and long discussions, reluctantly consented that West Ham, like Eastbourne, should also be regarded as exceptional. Having no other opposition, we at last obtained our object, and since 1882, I have had a staff of six building inspectors engaged in the supervision of the constructive and sanitary details of every new house erected in the district. The salaries of the staff are paid out of the building fees without any charge upon the rates. But why should West Ham have been put to all this trouble and cost to obtain powers which not only should it have possessed years ago, but which should be also extended to the whole country. Our neighbours, East Ham, Barking, Leyton, Wanstead, and Walthamstow, seeing our success and advantages, are applying to Parliament for similar powers. Thus local authorities are obtaining in detail, at considerable cost, the powers which would more cheaply and consistently be conferred by a public Act.

I think the illustrations I have given sufficiently indicate why houses are not efficiently supervised, and that the fault lies not with the local officer, but with the conditions to which he is subject, chiefly the insufficiency of staff.

With regard to the second point, insufficiency of power; outside the Metropolis there is no Building Act; the powers of the Public

Health Act are notoriously inadequate—the adoption of building bye-laws is not compulsory, a fatal defect—and when adopted, the powers, like the Act, are not only inadequate, but frequently not enforced for the reasons previously given. A few details will illustrate our argument. Great indignation is sometimes expressed against the local surveyor for permitting new houses to be occupied, as sometimes occurs, without first having the drains connected with the public sewer. This is how it happens:—A builder is under no obligation to put in his drains at any particular time. When his plans are passed, he can, of course, begin when he likes, suspend building and recommence at his convenience without notice. A jerry builder will put off till the last moment any expense he can avoid. Laying the drains from the house to the sewer is one of these expenses which he constantly postpones, until one day he finds a tenant and lets his undrained house. Unless the surveyor watches these houses week by week and day by day he will be defeated. When discovered, of course, there is the penalty, if the builder can be found, but he pleads forgetfulness, a mistake, &c., expresses his regret and the rest, and is let off with a nominal penalty. I am quoting facts. The remedy would be to make the laying of the drains compulsory at the proper time, that is, at the commencement of the building, in which case the surveyor would be saved much unnecessary trouble, and the occupation of an undrained house would be impossible. It is to be remembered that the bye-law prohibiting the occupation of a new house without a certificate from the surveyor has been declared to be *ultra vires.* There is another difficulty in connection with this matter. The local authority has no power to insist on laying the outside drainage from the street sewer to the exterior of the premises; any one can break up the roads and cut into the sewer, under supervision; that is to say, the local surveyor must attend anywhere and everywhere, at the bidding and convenience of the builder, to inspect drains, and very frequently when he attends the work is not ready for inspection; in fact, he may attend half-a-dozen times before the work is ready, and if he is not there at the right moment the builder will hasten to fill in his trench. Gas and water companies do not allow any but their own workmen to interfere with any main or lay any exterior service, neither should any one be allowed to interfere with outside sewers or drains excepting the local authority, and laying the drains should be the first operation in building.

Another difficulty is the making up of private streets for dedication, a subject bristling with difficulties both in the practical and financial features; but the complications of this subject are far too great to be discussed on this occasion. We all know too well the necessity for considerable amendments in the Act.

With regard to water supply, although there is power to compel a supply of water to a house, there is considerable doubt as to the power to compel a supply of water to a closet, and certainly there is no power to protect drinking water from pollution by requiring that the cisterns shall be constructed of proper materials, placed in a proper position, and protected by proper coverings, &c., and where proper bye-laws are not in force, which is optional on the part of the local authority, there is no power over the vital details of drains, traps, and water fittings.

Again, there is no power either in the Act or Bye-laws to require a minimum height in living-rooms, nor power to prevent timber in dangerous positions round hearths and fire-places.

Time will not allow us to pursue this branch of our subject. The public spirit of the West Ham Board has led them to amend these and other defects by applying to Parliament from time to time for private Acts, but all authorities cannot afford to go to Parliament, nor can we understand why they should, what is good for West Ham is good for all, and what is good for all should obviously be embraced in a general Act.

The third point with which we opened was the difficulty of obstructive local authorities, or of boards containing members whose sole object is "how not to do it," members who have secured their return to promote their own personal interests and protect jerry builders and small property owners from their natural enemy, the local surveyor.* Of these things some of the Members of our Association "could a tale unfold," but perforce we "speak with bated breath" because we have not that protection which the Local Government Board extends to workhouse officials. For obvious reasons we cannot enlarge on this branch of our subject.

During the infancy of our Association the subject of the protection of local officers was a prominent one. Most of us were strongly of opinion that it was necessary in the discharge of duties which brought the officers into antagonism and within the power of those who, in the language of the Royal Commissioners, are "interested in offending against sanitary laws" and who "constitute chiefly the local authorities." He who wears the shoe, knows where it pinches; and it is known only to those who have experienced it, what can be the fiendish malignity of the class with whom local surveyors have to deal when their pecuniary interests are thwarted. The first volume of our 'Proceedings' contains painful evidence by local surveyors, especially of the smaller towns, as to the necessity for protection. Such protection was given under the Towns Improvement Clauses Act, and during the existence of the General Board of Health; but, although retained in the Poor Law administration, was omitted from the later Public Health Acts. In 1872 a deputation of public officers interviewed the first President of the Local Government Board, Mr. Stansfeld, upon the subject. The President admitted his astonishment at the facts submitted, but opposed our practical experience by an academic view that the principles of local self-government, improved sanitary laws, greater public interest in sanitary progress, the spread of education and an improved constitution of local authorities would, in the end, accomplish all that we desired. All this of course meant the work of a generation or two, during which officers were to continue to suffer martyrdom in the interest of sanitary science. We were not quite convinced by Mr. Stansfeld as to the policy or the justice of taking from sanitary officials the protection they had, while retaining it for Poor Law officials, especially as both offices were brought under the same department; or why it was offered in a sort of diluted way to medical officers and inspectors of nuisances to the exclusion of the surveyor. We thought that officers charged with the administration of Acts of Parliament, in fact, local civil servants, constantly engaged in penal proceedings, were as much entitled to protection and superannuation as the more favoured civil servants of the Crown. We thought that after years of service, not of the most pleasant kind, we should not be at the mercy of a transient board of jerry builders, and that our status was as good and our function as important as that of a poor-rate collector, over whom the Government spreads its protecting *ægis*. But after an interval of twelve years we are bound to admit that some of Mr. Stansfeld's hopes have been realised. Wonderful progress has been made, and the position of local officers both professionally and financially immensely improved, so that some of us holding the larger appointments are not so anxious for protection as we once were, thanks to an improved appreciation of our services.

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* See Note at end of paper, p. 17.

I have not referred to the position and duties of the medical officer and sanitary inspector, they can better tell their own tale. The position of the sanitary inspector is doubtless a most difficult one, but one of the results of the activity of the medical officer and sanitary inspector is to put in action the surveyor, as the executive department, and thus bring him into conflict with property owners.

The last subject which I will venture to deal with is the qualifications of sanitary officers. It must be admitted that the charge of inefficiency has had some force with regard to some of the smaller towns, and even to larger towns which make small appointments. Sometimes these positions have been given as a reward for local party services, or out of charity—to a local builder, for instance, a "practical man," who had failed in his jerry speculations. There is on record the case of the appointment as surveyor, by his fellow townsman, of a bankrupt linen-draper, because "he had been used to measuring." But such things, if not very remote, are becoming things of the past. The greatest difficulty is in small places and with boards of small calibre; the remedy would appear to be in county government. The action of recent public opinion has resulted in the demand for and offer of better inducements to sanitary engineers and surveyors of professional standing and experience. Among our number are many members of the Institution of Civil Engineers, and of the Royal Institute of British Architects, and I think it may now be safely asserted that every important centre of population has the services of a fully competent sanitary surveyor, although he may be hampered in his work in the ways I have previously indicated.

A society, junior to our own, is seeking to impose on local surveyors an examination of competence, of which they, the Sanitary Institute of Great Britain, shall be the judge and dispenser of certificates. I think the Members of our Association would, in their own interest, generally assent to the principle of examination. We would even extend the principle further, and apply it to the members of local authorities. In a profession like ours, practical experience is of far more value than the cram and book-work which may qualify for a certificate but not for the responsibility of office. But, admitting the examination, who are to be the examiners—a newly-constituted society of persons having themselves no guarantee of qualification, or some of the older, chartered professional bodies which have our confidence? Our own Association is senior to the Sanitary Institute, and composed exclusively of, so to say, picked men—that is, sanitary engineers and surveyors by profession, each selected from a large number of other candidates, to fill a public office, without which qualification, no one is eligible as a member of our Association. If it be objected that we should not give confidence by examining ourselves, then we have the Institution of Civil Engineers and the Royal Institute of British Architects, having charters half a century old. The latter body, of which I have the honour of being one of the Board of Examiners, is charged by Parliament with the duty of conducting examinations for the office of district surveyor under the Metropolitan Building Act, and the Institute has extended the examination to the office of local surveyor. The diploma of the Royal Institute of British Architects would certainly carry greater *prestige* than that of a newly-formed non-professional society. There are also the Universities, or the Civil Service Commissioners, or a joint examining Board might be formed of some of these bodies. We have no antagonism to the general objects of the Sanitary Institute, of which body indeed I am a Fellow; we wish the Society every success in educating the public and promoting sanitary progress, but, as professional engineers, we decline to admit the claims of a new dilettanti society to examine us.

Although there are many subjects to which one would like to refer on such an occasion, time demands that I should bring this paper to an end. Much that I have said, I have said in effect elsewhere. My object to-day has been to show that as sanitary officers we are, and have been for years past, actively interested in our duties; that, as a class, we are neither incompetent nor negligent—but "cribbed, cabined and confined;" and we respectfully suggest to our critics that they should direct their attention to legislation, and to the constitution of the bodies by whom we are controlled.

NOTE.—*Since the above was written (see page* 14), *another practical illustration of one of the defects of local government has occurred. In an important district where buildings are proceeding very extensively, the Model Bye-laws, recommended by the Local Government Board, had been adopted, and the surveyor was honestly endeavouring to enforce compliance therewith, but the speculating building interest have at length succeeded in returning a majority of their own class as members of the Board to frustrate the action of the surveyor, whose master they now are.*

SANITARY LEGISLATION AND ITS ENFORCEMENT.

By Professor HENRY ROBINSON, M. Inst. C.E., F.G.S., F.M.S.

The Public Health Act of 1875, and the Metropolis Local Management Act of 1855 (the latter Act constituting the vestries the sanitary authority for the Metropolis), contain provisions for the protection of the public from avoidable sanitary dangers, which if vigorously put in force would remove many evils which call for drastic treatment. If these Acts were framed now, they would doubtless be drawn with less of the optional or permissive and more of the compulsory element than is found in them. At the time, however, when they were passed, public opinion was not nearly so alive as it is now to the consequences attending sanitary neglect. The mass of the thinking part of the community will now appreciate and support any legislation which has for its object the amelioration of the condition of the poorer classes, and the enforcement of those laws which are essential for the sanitary well-being of the people.

It is a fact that in many respects even the existing mild legislation is not put into operation. This arises from two causes, one being the ignorance or indifference of the sanitary authority to carry out the powers entrusted to them, the other being the legal difficulty and expense which an individual ratepayer has to meet in order to compel his sanitary authority to exercise their powers, when they have failed to do so.

Time will not permit of more than a passing reference to some of the many points which admit of being dealt with. Take one which is of very common experience. The sanitary authority is either apathetic or obstinate as to remedying a condition of things which is injurious to health. The evil and the remedy are both obvious. The Acts prescribe that the course of action is by representations to the officers of the authority. But these officers may be the offenders themselves, either by neglecting to take the matter in hand, or by being unable to obtain from their authority the necessary permission to rectify it. This neglect or want of appreciation of the evil by the authority is of constant occurrence, and is due to the fact that a very large number of those who compose the corporations, local boards, and vestries are deficient in zeal for the public good, as regards health, and in many instances have vested interests directly antagonistic to any action being taken. Where the desire to suppress inquiry exists it is difficult for it to be brought about. The officers are all appointed by the board. A too zealous official soon gets removed. The remedy, we think, is for the Local Government Board to take prompt action on the memorial of any ratepayer, and to take the necessary steps to immediately remedy the evils complained of. Further, the sanitary inspectors and similar officials should not be wholly dependent on the sanitary authority. It is also very necessary for all officers of health to be subjected to an examination to test their fitness for the duties they seek to discharge. In our experience most unfit and incompetent persons are appointed by local authorities to administer the Public Health Act. Having acted for some time as one of the Examiners of the Sanitary Institute of Great Britain in granting diplomas for surveyors and inspectors of nuisances, we have had opportunities of testing the fitness of many men holding important positions of this kind.

A great amount of preventible mortality arises from houses being occupied which do not conform to the most elementary rules of house sanitation. Those who have had to examine into the causes of epidemics will support the statement which we make that there exists throughout the country a large amount of house property from which the landlords should be prohibited from receiving rents, and which should be condemned as unfit for habitation. The Legislature has very properly made it a penal offence to sell adulterated food or bad meat. Surely it is equally a culpable act to receive rents for house property which breeds fever and destroys the vital energies of the occupants even where it does not destroy life. This class of property is generally represented on the local boards, and there should be a swifter means than is now used to remedy this evil.

A fruitful source of mischief arises from defective drains, water-fittings, and plumbers' work, which being hidden from sight is often performed by unskilful or dishonest men. This class of work requires the most stringent regulations to ensure its proper execution. We would require every man engaged in it to be certificated and registered, as we are confident that without such a system to protect the public the existing bad work and consequent mischief will continue.

We might advantageously copy the example which has been set us by the City of New York. In the year 1881 an Act was passed to secure the registration of plumbers and the supervision of plumbing and drainage in the cities of New York and Brooklyn. This Act was the outcome of a public movement which was set on foot by those who appreciated the evils we have referred to. Amongst the most prominent of these reformers, and the one to whom the passing of the Act is chiefly due, was Mr. Henry C. Meyer, the proprietor of the *New York Sanitary Engineer.* The powers which the Board of Health of New York have been granted by the State with reference to tenement houses are of the most sweeping kind, and are as clearly defined and capable of easy enforcement as the law relating to plumbing and drainage. We have before us the sanitary code of the same Board of Health which was issued in April of this year, and we commend it and the before-mentioned Acts to the consideration of all who are interested in the administration of sanitary rules and regulations. It should be mentioned that in the Health Exhibition there is an exhibit of Mr. Meyer, of New York, for the purpose of showing to the British public how the State of New York has dealt with some of the sanitary evils with which we are grappling.

It had been our intention to have referred to several other matters, but the time at our disposal does not admit of it. All that we have attempted is to touch briefly and imperfectly upon a few points in response to the invitation from your Institution to contribute a paper at this meeting of the Municipal and Sanitary Engineers.

THE EFFECT OF MUNICIPAL GOVERNMENT UPON SANITATION.

By H. PERCY BOULNOIS, M. Inst. C.E., Borough Engineer, Portsmouth.

We have but to glance at the money-market column of any of the daily papers to see some of the large sums of money that have been borrowed from time to time by local authorities upon the security of the rates, and we may fairly assume that these sums have been nearly all expended in carrying out useful and lasting sanitary works; in addition to this there are also the loans, similarly borrowed and expended, which are not quoted upon the Stock Exchange.

The power to borrow these immense sums has, of late years, been to a great extent under the control of the Local Government Board, and we may assume that a beneficial check has been thus placed upon the manner in which the money is expended.

In a paper of this description there is not space to enumerate all the regulations under which money can be raised for these purposes, but the sum must not exceed at any time (including all outstanding debts), the assessable value of the district for two years, and where it exceeds one year the Local Government Board will not give their sanction until after a local inquiry has been held by one of their inspectors. The money can only be borrowed for permanent works, nor for a longer period than sixty years, during which time it must be paid off.

These arrangements are fair and equitable, both to the present and future generation of ratepayers. The powers thus granted have given a considerable stimulus to the execution of sanitary works, which it would have been obviously unfair to pay for out of the current rates, as chiefly benefitting posterity, and consequently nothing would probably have been done.

Without enumerating those duties which fall without the province of the borough surveyor, I will pass on to speak of such duties and works as should be carried out by a local authority who have at heart the interest and health of the community they govern, and endeavour to point out where such permissive legislation frequently fails.

The water supply should certainly be in the hands of the local authority for obvious reasons, yet how frequently they fail to secure this primary sanitary necessity, owing to the fear of interference with vested interests or the first cost of the acquisition. In some instances even worse neglect is shown, where the authority permits an insufficient and impure supply of water to be used, instead of using the powers under Sect. 70 *et seq.* of the Public Health Act 1875, and thus provide themselves a pure and sufficient supply of wholesome water.

Although many local authorities have acquired the gasworks of their districts, it is a commercial and not a sanitary question, though the annual profits derived from their acquisition may of course be devoted to sanitary purposes. It is, however, possible that the attention which the members of the authority must give to the economical working of such undertakings may deter them from acting with vigour upon less popular sanitary measures, which have apparently nothing to show to the ratepayers but expenditure.

The sewerage of the district must of necessity be in the hands of the local authority, and is second only in importance to that of the water supply. Here permissive legislation sometimes leads to nothing being done, under various pretexts, and the difficulties which no doubt surround the questions of a complete and efficient water-carriage removal of the sewage and its ultimate disposal are made the excuse for inactivity. Although the main sewers are under the sole charge of the local authority, it can scarcely be said that the whole sewerage is so relegated, for the house-drains are not, and these are of equal sanitary importance with the main carriers. The Public Health Act 1875 certainly gives powers of supervision over the construction of house-drains, but any one practically acquainted with the matter knows that such supervision is generally inadequate, and a mere form, and that it would require a far larger staff of officials to stand over irresponsible workmen engaged in such operations than a local authority is at all likely to supply. With regard also to defective existing house-drains, some easier and less cumbersome modes of procedure than those afforded by Sect. 41 of the Public Health Act are much wanted in order to secure a prompt remedy for such evils. The delay now necessary in dealing with such cases renders action almost useless, and a few authorities have been obliged to obtain private Acts in order to assist them.

I will take scavenging as the next most important sanitary duty. We all know the dangers to health which lurk in a neglected dustbin, but unfortunately the work of house-refuse collection is so unostentatious in its character as to cause little enthusiasm amongst the members of the authority, and the tendency is to starve and pinch this necessary though unproductive work, whilst large sums are lavished upon public parks or similar popular and showy works. The custom also of storing large heaps of house-refuse is much to be deprecated. This is done in order to effect a sale of some portion if not all of it, and thus bring in a small revenue, which the local authority are sometimes loth to part with.

The maintenance of the public streets falls upon the local authority, and this duty also includes their lighting, cleansing, and watering. All such work is seen and closely watched by the ratepayers, and is consequently efficiently carried out within the means at their disposal. Some improvement, however, is needed in the methods of procedure where new streets are required, as great cost for compensation has frequently to be incurred.

Upon the local authority rests also the duty of providing cemeteries, and sometimes mistakes are committed in the selection of suitable sites, as regards soil and position, &c. No doubt as population increases cremation will have to be substituted for the present system of burial.

The local authority should provide in their districts public slaughter-houses, infectious diseases hospitals, mortuaries, and public baths, but with the exception of some of the larger boroughs very few towns are furnished with these necessary sanitary adjuncts. In executing such works also, a false economy has sometimes guided their erection, and the practice of accepting the lowest tender after public competition is not always the wisest course. All public works should be of the best and most substantial first-class work, scamping should be inadmissible as it is the most costly in the end. In addition to the above duties the local authority have power over all new buildings or streets constructed in their district. They deal with private streets, dangerous buildings, houses unfit for habitation, cellar buildings, lodging-houses, and a host of every-day public necessities too numerous to mention.

Such are some of the many powers conferred upon local authorities, and if properly used these powers must tend eventually to the general benefit of the community. Although in many cases the local authorities have carried out their duties in spite of clamour and opposition, there are unfortunately on the other hand notorious cases where permissive legislation has been a dead letter.

It is an established fact that some sanitary measures can only be carried out by compulsion; each householder considers his home to be his castle, and any interference by the local authority as an impertinence, and as the members of that authority have each in their turn to seek re-election they frequently think more of carrying out some measure that may bring them popularity rather than the real sanitary benefit of their district. This composition of the authority, with its ever-changing members, makes it often an unwieldy and difficult machine to move. It is not an easy matter to decide how an alteration either in numbers or constitution can be effected, but at the present time it is notorious that some local authorities consist more of the busy-bodies and orators of the district rather than of those who have a higher stake in the community and a sounder judgment for the important duties devolving upon the authority. Their officers should be able to act firmly, and not only without fear of giving offence to those under whom they serve, but also with the conviction that they will be faithfully supported in their honest endeavours to enforce the different clauses of the Public Health Acts, which unfortunately is not always the case.

DISCUSSION.

Capt. **Douglas Galton**: I am not going to intrude upon the general question so much, as to make a few remarks upon a paragraph in Mr. Lewis Angell's paper respecting the Sanitary Institute of Great Britain, of which I am a member as well as one of its examiners. I wish rather to defend the Sanitary Institute in the course of action which it has taken. It must be remembered that, although it may be a junior society to this, the Sanitary Institute was the first society which suggested the examination of surveyors and sanitary inspectors in order to test their qualifications for their respective offices. The examination is a purely voluntary one, and a very considerable number, both of sanitary inspectors and surveyors have been examined. The results of the examinations were certainly for years very unsatisfactory, that is to say a very large number of those who attended for examination certainly were not qualified for the work they were proposing to undertake. In recent years, however, I must say that the proportion of those who passed has very much increased. But what I wish rather to say is, that the Sanitary Institute has led the way in these examinations; and it is absolutely necessary that those persons who undertake the duties of surveyors of towns and of sanitary inspectors should be qualified for their work. A medical officer is not appointed unless he has obtained some diploma, which certifies that he is fully competent; and I maintain that there should be a similar diploma demanded from sanitary inspectors and surveyors before they undertake work which so eminently concerns the health of the community. I do not say that the Sanitary Institute is the best body for this work, but what I do say is, that some examination should be required. There are plenty of colleges and universities throughout the country—there are, for example, the Universities of Oxford, Cambridge and London, Owen's College and Victoria University, and the Universities of Dublin, Glasgow, Edinburgh and Aberdeen; and my own view is, that a diploma from one or other of these seats of learning should invariably be required before any surveyor or sanitary inspector is allowed to hold office. But having obtained that diploma and obtained an appointment under it, it is equally necessary that some protection should be given to a surveyor or sanitary inspector in his office. He should not be liable to be turned away, at a moment's notice, after four or five years' service, by the board or body he is serving under, without the power and the right to appeal to some such central authority as the Local Government Board. I hold examination and a diploma of some sort to be most essential if we are to secure in towns, and throughout the country, properly qualified surveyors and inspectors, competent to discharge their duties. I hope the President of the Local Government Board will kindly consider this matter in the next Bill which he introduces into Parliament for the regulation of sanitation in this country.

Mr. EDWIN CHADWICK, C.B.: I beg to say a few words on this subject of the qualifications of officers. Now one object of the plan of administration which I had the honour to propose for the Poor Laws was, to enlarge the area, the local unit of administration, from the parish to the union; and the great object of that was, to get qualified officers for the work in the large areas that could not be afforded in the small ones. That has to a considerable extent been done. In my view the unions are not yet large enough as local administrative units, but I could not carry them so far as they might with advantage have been extended; and I think, on a fair revision of local administration, it will be necessary to enlarge the unions, with the object of obtaining officers with higher qualifications and a better local organisation of administration than at present exists. Those town surveyors whom I am addressing, who are officers of municipalities, will generally be aware how much their administrative organisation wants enlarging. Generally they will be found cramped and confined, especially when there is a great population crowded in narrow limits, which excludes them from the great works of sanitation, which must be undertaken outside the present administrative areas. I may, for example, instance the city of Manchester, where the Corporation proper has only jurisdiction over about one-third of the whole of the proper area, meaning by the proper area all the connected houses forming one town or city. They have not the jurisdiction which they ought to have over the area necessary for land drainage, the disposal of the sewage and other purposes, that is necessary for the health and the economical administration of the population. I think that the future administration must go in the way that it was intended to go, namely to the most complete organisation that can be effected, to obtain science and skill and officers qualified for the execution of administrative wards. The best qualified service is cheap service. You will never get good work, except with high qualifications, and these must be the subject of a special examination. My own view was, and is to a great extent, that the examination should be charged upon the chief sanitary authority. I do not think it is right to admit solely, the outside certificate of some irresponsible body. I am a Vice-President of the Sanitary Institute, and I think, in its position, it is doing good and important work. When taking medical officers for the practical administration of the Navy, the naval authorities have them re-examined, whatever degree they may have obtained elsewhere, and this is done as a security for the operations of the service and against the defects of the previous examination. I am clearly therefore of opinion that it is greatly for the advantage of the local public that the certificate of skilled, qualified, and important examination under the chief authority should be maintained and extended. One thing we are talking of is contracting or diminishing the expenses of local administration. Nothing can exceed, in my view, the wastefulness of the ignorance of local authorities, involving frequently double expenditure on a large scale. My object was generally as stated in the report, that responsibility for the future for executive work must be by well qualified administrative officers; where you have no payment you have as a rule inferior attention, inferior qualification, the wastefulness of ignorance, and no real responsibility, and my view was that the duties of the unpaid should be simply supervisory, whilst the real executive authority should be with the responsibility—that is, with the paid officers. For the advancement of local government and the protection of the ratepayers against the wastefulness of ignorant and irresponsible rate expenders, much amendment will be required in the organisation of the central authority. Much evil and loss has been incurred by the substitution of a sham Board who cannot attend and who never meet, for a real Board of specialists who constantly attended to the work; and by confiding authority to a changing political chief who rarely can attend to the duties. The Minister by whose presidency we are honoured is a very marked exception. But when he has succeeded in acquiring a full knowledge of the principles for the exercise of his functions, he may, as experience shows, be succeeded by some one else blinded by prejudice against those principles and obstructive of their advancement and execution. I have deemed it a duty elsewhere to display the costs of non-feasance and retrograde central administration in nearly double local charges and continued evils. I think that is a thing for administrative organisation, which will have to be regarded for the future;

but I hope and believe a revision will be had early of the existing administration, of the needs of altering local areas, and of extending and modifying them; and these changes will all be in the direction originally intended. I am quite confident that the work you have before you is the largest of all economies. We have no economy equal to the economy of preventible sickness and preventible mortality. The extent of the preventibility of sickness and mortality has to a large extent been proved. In towns where the death-rate was 28 to 30 or more per 1000 of the population, by a partial application of sanitary principles, the death-rate has been reduced by one-half or by one-third. There is the case of Croydon, where great difficulties were experienced, but the death-rate has been reduced from 28 to 13 per 1000. This, with proper legislation, may be extended, especially by that course of legislation in which I hope our present President will take an active part—the question of the housing of the poor, and of the removal of slums, of which we have in the Metropolis and elsewhere very practical examples. I hope, Mr. President, you will give your aid in the promotion of these reforms, which will be found to be returns to the principles originally propounded, the soundness of which has been demonstrated by experience.

Mr. Ellice-Clark: I will not attempt to follow Mr. Chadwick in the enlarged views he has taken as to the administration of public health in this country, because I think it would be an impertinence on my part to enter into a discussion of that kind. Most of us are impressed with the great need there is for a Minister of Health, whose whole time and sole attention should be given to sanitary questions and to nothing else. I am afraid the Right Hon. Chairman will be inclined to think that the readers of papers to-day have been dealing with professional grievances in detail, instead of general principles. But ours is a life of detail; our whole official experience is dealing with details, and general principles, as a rule, are left to the local authorities we serve. One would also be very glad that this discussion should not take the form of a dispute, or wrangle, between the Sanitary Institute of Great Britain and the Association of Municipal Engineers. At the same time, I think that the dignity of this Association has been somewhat compromised by the attitude which the Sanitary Institute of Great Britain has taken up with regard to the examination of surveyors. The Sanitary Institute of Great Britain has an ample field before it in educating the public as to the necessity of enforcing sanitary measures, and might have left to the institutions Mr. Angell has mentioned in his paper, the examination of surveyors. Captain Douglas Galton very properly mentioned that the Sanitary Institute was the first association which thought of the examination of local surveyors. I do not think that proves anything, for while the Institution of Civil Engineers, perhaps the most successful scientific society in the kingdom, admits members without examination as to competency, surely local authorities may be satisfied to accept surveyors and sanitary inspectors somewhat in the same way that the institution elects its members. In my opinion an examination would not necessarily prove a man's competency for an appointment as local engineer. We know it is the practical experience of engineers of large towns, that assistants who have matriculated at universities, when put to the practical duties of municipal engineers have failed to carry them out in a proper manner. Captain Douglas Galton says he thinks all local surveyors ought to have a diploma. What kind of a diploma could that man be expected to have who is offered a salary of 120*l.* a year? Why, the thing sinks into ridicule. It is preposterous to suppose a man will obtain a degree from a university to obtain a salary of 120*l.* a year. One is sorry to have to mention any particular town, but I see the great borough of Northampton is advertising for a surveyor at a salary of 200*l.* a year! 200*l.* a year! Why, I am carrying out a work at this moment, where the clerk of the works is paid four guineas a week. Yet the two offices cannot be compared—one is a man who has simply to carry out what he is told, the other, the surveyor of a town, who, perhaps, has charge of the water supply besides all the ordinary duties, and possibly the enforcement of a stringent local Act. Mr. Chadwick had wisely advocated the enlargement of areas. No doubt that would in rural districts bring about considerable change, but I think the remedy lies here in the passing of a County Government Bill. Captain Douglas Galton said that a medical officer could not be elected under the Local Government Board without a diploma. True, a medical officer might have a diploma, but it does not touch the subject of public hygiene at all, therefore the argument does not apply. In fact, it is within our own experience that medical officers are elected, who, although they have regular diplomas, have not the slightest knowledge of their public duties. If the diploma included an examination in public hygiene, I think that would be a very good thing. The large number of subjects to which Mr. Angell has alluded, precludes the discussion of them to any extent. Some of his points are singularly striking, and have been borne out by our experience. He alluded to a case where the assistance of a boy had been grudgingly allowed to a surveyor. Well, when I was acting as borough engineer at Derby, the Council actually went to a division as to whether the sole office assistant should receive 12*s.* a week or 30*l.* a year. There is no doubt that staffs are notoriously inefficient. Mr. Angell is to be commended, in that he has done the local public a great service in obtaining for West Ham what should be the general law of the land, viz. the payment of building inspectors by fees levied on the builders; this has only been obtained by persistent agitation on his part, and high-spirited action on the part of the West Ham Local Board. Suppose West Ham had adopted the Model Bye-laws of the Local Government Board. They enumerate 300 distinct observations, irrespective of drains, before a house is completed under these bye-laws. Mr. Angell says there are between 2000 and 3000 houses being built annually in his district. Probably in Manchester and Salford and Liverpool the number of new houses is equally large; and we know that outside London towns are growing enormously. It is therefore simply impossible that the surveying staff grudgingly granted by the present local authorities, can even see that the mere carcase of a building is properly carried out. I think the right of local authorities to demand fees for supervising the erection of buildings is the solution of the whole question, although great objections have been raised to this course being adopted. With regard to the "protection" for surveyors, it is a very delicate subject; but on no former occasion have we had a gentleman in our midst before whom we might, in some small degree, lay our woes. The question of protection is an exceedingly difficult one, because the spirit of the age is to extend local government. One can see this in almost every direction, and if you are going to deprive the local authorities of the power to dismiss their own officers, it appears to me you will be greatly curtailing their functions. I say this, however, emphatically, that it is perfectly impossible for a large number of local surveyors to do their duties in a manner which the Local Government Board would approve, if they knew the whole of the circumstances of the case. There may be sitting on committees the very individuals you may be prosecuting under the bye-laws, and next week you may have to go to them to ask for an increase of salary or of your staff. Now, although I have an exceptionally good board, and have very little cause for complaint, yet I shall not hesitate to mention a case which will prove this up to the hilt. Within a few years I had to prosecute six builders for using bad mortar, when two members of the local authority went into the witness-box to prove that it was exceptionally good mortar. One of them was actually sitting upon the committee when the prosecution was ordered to be instituted, and six months afterwards both of them had to consider an application from me for an increase of salary. They would not have been human if they had not objected to the increase, or indeed to anything that would increase the status of the surveyor against whose opinion they had recently been witnesses. Mr. Angell has put a case where the weight of evidence carried the day against the surveyor. In the case which I have named, we had to obtain thirty-six distinct analyses to prove that "muck" was not mortar. My opinion is that such cases should not go before local justices at all; but that a special tribunal of experts should be constituted to deal with such cases. I hope that Sir Charles Dilke will permit me to press upon him the necessity of giving all possible support to surveyors in carrying out the Public Health Act, which their really difficult position requires.

Mr. C. Jones: I have only a very few words to say, as I am satisfied there are many present who will deal with these subjects more efficiently than I could possibly do myself, because some of them know (as Mr. Angell has observed), where the shoe pinches. Some of you will say, "Yours has been a very happy lot, and you have very little to complain of." Well, it has been so; but still I can sympathise with those who have been less fortunate, and I congratulate the Members of the Association that they can now lay their case before one whose sympathies I well know are fully with them. We need make no apology for meeting here. The fact that men are here from all parts of England, from the north, the south, the east and the west, proves the deep interest which they feel in the work in which they are engaged, and for which they are so well qualified. The question of fees, to which Mr. Angell has alluded, although at first sight quite a foreign matter, really touches materially upon the principles on which we have to take our stand. Supervision of new buildings is all essential, and I think the Public Health Act does not give us that power which it should do. Still the Act does give us a considerable amount of power if we had the machinery to properly carry it out. I find no difficulty in my district, simply because I have a Board which supports me in these matters firmly, and a bench of magistrates which practically says, "Bring your jerry builders before us, prove your case, and we will then very soon settle the question." In illustration of this: a few days since I met a person coming to my office, who had just done fourteen days in Wandsworth Gaol because he would not do what was required. He had set the bye-laws at defiance, was summoned, and fined, and as he either would not or could not pay, had to go to prison. It was a sharp lesson, but it has had a most salutary effect in my district. I am sure we all feel that there should not be any such anomaly in existence as that one town should be able to charge fees for the supervision of new buildings, and employ a proper staff of men to see the work carried out to the fullest extent of the bye-laws, but that other towns, perhaps adjoining, are not allowed to do the same. Mr. Angell, for example, is empowered to charge a small fee, and he has six assistants with salaries of 200*l.* a year each to carry out the work. What a boon that must be, and what a guaranteed security to the public that these houses are built under such wholesome supervision. A similar clause should be inserted in the Public Health Act, so that the necessary supervision might be provided by fees paid by the persons who required the service, and the money would not have to come out of the ratepayers' pockets. I cannot but feel we are right in pressing this question upon the Local Government Board, and upon the head of that Board, who is now present. In connection with the Model Bye-laws, which upon the whole are very valuable, one point, with respect to the important question of drains, has been touched upon to-day. The outside work connected with the construction of a building can be seen readily, even by persons passing by, and if the bricks or mortar were bad, attention was likely to be directed to the fact, but the drains, which are even more important, could not be inspected, and there is no power to deal with them under the Act. I have a case in point. I send the Model Bye-laws to the Local Government Board, with amendments dealing with drains, and they were returned to me with the intimation that there is no power given by the Act to make the amendments which I suggested. Now what was my suggestion? Simply that the Board's officers should have power to supervise the laying-in of drain-pipes, and that the builder should not cover them up after they had been laid until the surveyor had inspected and approved of the work.

I consider this a most important point, and one that should be dealt with promptly. I am perfectly aware that the ninety-third bye-law upon the face of it appears to give this power, but it is not so really. A builder who chooses to be troublesome sends a notice at 11 o'clock, that his drains—perhaps at the extreme boundary of the district—will be ready for inspection at 12 o'clock; the drainage clerk is away on his work, and when he goes in the afternoon the trench is filled in. A reasonable time should be fixed. Again, why should not the Model Bye-laws be made absolute in all districts alike. Two adjoining districts have Model Bye-laws, but in one of them they are not strictly enforced because there are two or three members on the board there who say, "Do not be too stringent with Mr. So-and-so, he is a very respectable builder; and don't press him too much." This might be rectified also when the Public Health Act is revised, and I hope it will be revised before long. With respect to Northampton, to which Mr. Ellice-Clark has alluded, I was ashamed when I saw the advertisement. Some years ago such things used to be, but I had hoped that those times had gone by for ever. Yet Northampton, an important borough, offers 200*l.* a year, and expects to get the work done properly. On the question of examinations I will not say much; I think perhaps enough has already been said on that subject. I think a person who has served his time to an engineer or surveyor of repute, who has been engaged in sanitary work for years, and been admitted as a member of the Institute of Civil Engineers, holds a position above and beyond any examination emanating from any self-constituted examining body. I say this without intending any disrespect to the Sanitary Institute. With respect to the question of protection, Mr. Rawlinson once said, when a man falls foul of his board, the sooner they part the better. There is very much truth in that remark; and it is not only true, but is simple common-sense. For a man who is carrying out the duties of his office under the protection of the Local Government Board, but at variance with his own board, would find himself in a very unhappy position. No doubt in many cases the surveyor's position is a very hard one to hold. I was very much grieved, when this question was raised some time since, at a northern meeting, on a surveyor of a large town saying to me, "My dear sir, my place under my board is like a little hell upon earth." It ought not to be so; no surveyor in charge of a large district should be placed in such a position. I do not suggest a remedy, I simply offer these observations, following up the remarks made by Mr. Angell and Mr. Ellice-Clark; and I hope the seed which we are sowing to-day will take root and bring forth much good fruit, and be to the advantage of all in connection with the Local Government Board.

Sir **Charles Dilke**: I think, gentlemen, it would be a convenient time now for me to offer some few remarks which have been suggested to me by the papers read, and the speeches which have been delivered. In the first place, I am very glad indeed to have this opportunity of meeting a representative assembly of the municipal and sanitary surveyors throughout England, and of saying that, in the discharge of the duties which have been thrown upon me, not only as President of the Local Government Board, but also as Chairman of the Royal Commission on the Housing of the Working Classes, the great evils which I have found existing throughout the country in connection with sanitary matters generally have not been in those departments which come chiefly under the control of the surveyors. I think the exceptions which still exist to the enormous general improvement which has taken place in matters connected with sanitary science and the public health throughout the country, are chiefly with regard to matters which do not come directly or immediately within the province of the surveyors. Generally speaking, I am inclined to think an enormous advance has been made in matters with which you are chiefly concerned. A general advance has been made, though no one has stated in general terms what the advance is. There is no doubt that there has been a great diminution in the death-rate, and though, taking place by place, it is not general, yet taking the general death-rate of England, and comparing it with the death-rate of other countries, there can be no doubt we have made most important strides, and to no one is the credit for this more due than to Mr. Chadwick. The exceptions to this general advance which I have come across, concern very large districts which are not within the control of any urban sanitary authority at all, but as to sanitary matters are under the jurisdiction of boards of guardians not possessing urban sanitary powers. Then again, there are enormous drawbacks to the sanitary condition of the Metropolis still in existence. Not only is there a good deal of conflict of local authorities, but also the difficulties with the aggregation of population in the Metropolis. Hence London is no fair test of the state of the country generally. The surveyor's work in the Metropolis is different from that of local surveyors in the country; that which in a borough would be done by the municipal surveyor is done partly by the surveyors of the Metropolitan Board of Works and partly by the surveyors of the various vestries and district boards. There are, in fact, no less than thirty-nine different authorities in the Metropolis; and I am bound to say, although I wish to avoid anything like controversial topics, I have a strong opinion that it will be impossible to get rid of the hindrances which exist to sanitary advance in the Metropolis without some further concentration or unification of the different authorities. With regard to what I have seen in rural districts, there are still places where the drinking-water of cottages is drawn from small ponds into which the excreta from the cottages is discharged. I noticed the other day, at a station between Birmingham and the well-known cottage homes of the Birmingham Guardians at Marston Green, that the drainage from cottages goes into a small pond from which the drinking-water for these cottages is drawn. I have seen in Essex, Surrey, and the west of England, examples of the same thing; but I have not come across such evils in urban sanitary districts. We have, of course, certain grave exceptions, showing themselves from time to time, to the general improvement in the general health of the country. For instance, the most painful epidemic this year has been at Kidderminster, and we have also had an epidemic at Beverley; and there has been lasting continuous typhoid and an epidemic of small-pox at Liverpool. But all these, so far as I have seen the reports, seem to be due to causes which do not come within the province of surveyors; I think they arise out of other people's business rather than yours. So also with regard to the pollution of the Thames, the River Lea, and the Cam at Cambridge—all these are matters which do not imply any negligence or want of attention to their duties on the part of the surveyors of this country. Generally, I should be inclined to congratulate the surveyors on the progress which has been made, and I think very little fault need be found with those matters which come particularly under their care. Passing from general considerations to details, there has been a complaint made to-day that a good many of those who are members of local boards of one kind and another are interested against sanitary reforms; and that this element is an immense difficulty in the way of surveyors, as, of course, it is also in the way of medical officers of health. This is no new charge to me. It is a charge I myself have made in Parliament against the local authorities of some districts, and it is one that can undoubtedly be substantiated by an immense amount of information which comes into one's hands every day. Now comes the question,—how is that difficulty to be got over? It is suggested in one of the papers to-day, that the Local Government Board should take prompt action itself on the memorial of any ratepayer, and also take the necessary steps to remedy the evils complained of. These terms are a little vague, and I should like to examine before you the various meanings they might bear. At present, where any inquiry is made by letter, suggestions are sent down; but in any startling case, where the public health is involved, an inspector is sent down at once. But as to the Local Government Board doing the work itself, or becoming responsible to the public for its performance, there you will find there are enormous difficulties in the way. I do not think any Local Government Board Department could be made sufficiently large, or could have a staff large enough, to deal with the enormous amount of work which would be thrown upon it. The Local Government Board has the power now, under certain circumstances, to declare a local authority in default, and to step in and do the work itself. But this is a power which has not been acted upon, and except in some very great emergency, jeopardising the public health in some given place, I do not think it is a power ever likely to be exercised, for obviously the difficulty of doing so seems enormous. Then comes the question of the examination of local surveyors. That is a matter which has been brought very prominently before the Royal Commission of which I spoke just now. We have had such an examination suggested in the evidence before us, and one member of the Commission, Mr. Godwin, has a strong opinion on that point. I must not anticipate what the report prepared with the assistance of my colleagues will be, but I think it probable that some allusion will be made to this subject in our report, and we shall possibly also make some suggestion with respect to it. Mr. Ellice-Clark, in his admirable remarks, has summed up very concisely the difficulties and the arguments on both sides, upon what is called by you protection. I think nothing could be better than the way in which he has stated the case. The readers of papers to-day have referred to the somewhat similar case of Poor Law officers, and have shown that they possess this protection. But I may say that the supporting of a local officer against the wishes of those who appoint him is a very difficult matter indeed, and in very few cases would be attended with anything like success.

If a local authority wants to get rid of an officer, they manage to make his position unbearable; and I do not think it will ever be possible, except in cases where the division was very close, and there was only a majority of one or two, to support a Poor Law officer against the general wish of the local authority. As regards Poor Law officers, there is a large contribution from the State towards the payment of some of their salaries, just as there is also towards the maintenance of police; and this fact gives very much stronger grounds for State interference. This is much more the case in London than elsewhere, because, in the Metropolis, not only is there the large grant from the State, but all the metropolitan parishes contribute towards a common poor fund. This makes possible a larger amount of central interference than could be exercised elsewhere. Generally speaking, from what I believe to be the feeling throughout the country, I do not think it likely that by any future legislation—whatever Government may be in power—will it be proposed to give increased central control to the sanitary department. There is another course which may possibly be taken, and it has been suggested here to-day by two persons, by the reader of one of the papers, and by one of the speakers, and that is, that there should be something between Government control and purely local control. By changing the county government to the local government system, it may be possible to introduce an appeal from one small elective body to another larger authority covering the same area. This would not have the same objections to which a central London control is open, and I have always thought that it would be possible to give a great number of powers of appeal against the action of small local authorities to a large representative county authority, which might be a proper court of appeal for such purposes. In conclusion, I should like to allude to one or two things which have been said with regard to similar points, and other matters upon which it might be desirable legislation should take place. I have no doubt that the Royal Commission to which I have alluded will recommend legislation on various matters, although I do not think they will recommend any very violent or sweeping changes. I think the general drift of our report will be in the direction of the better enforcement of existing legislation rather than of any greatly increased legislation for the future. I may say there is enormous difficulty in the present condition of affairs in Parliament, in carrying a small bill through Parliament. It ought to be clearly understood that the power which the Government possessed some years ago of carrying their smaller measures is a power which has ceased to exist, and is not likely to be revived. I should like to encourage these smaller matters being dealt with by private members. When it is agreed or supposed that some changes in the Public Health Act are desirable, it is a very proper thing indeed for people to put their heads together and talk the matter over with the Government department, but you should try to interest private members on both sides of the House, and if possible induce them to co-operate in carrying these smaller measures through Parliament. Formerly a Government had greater power and facilities for carrying smaller measures, but things have changed, and now it is far easier for a private member to carry such a Bill. If Government introduces a Bill it is very often opposed and stopped, simply because it is a Government measure, but Bills by private members, especially if supported from both sides of the House, are treated on their merits, and if their merits are obvious, and recognised by both sides, they are readily passed into law. Therefore, I would ask you not to look so much for the intervention of Government, but to see whether you cannot induce private members on both sides of the House to take the necessary steps. I have only now to thank you for the kindness with which you have listened to my remarks, and to again say how pleased I am to have met the Members of this Association.

Mr. W. H. White: Very little remains for me to say with reference to these papers. With Mr. Angell's paper I cordially agree, and I have nothing to say upon it in the shape of criticism. In the course of his paper, Mr. Angell spoke more than once of the Model Bye-laws, and Mr. Jones in his remarks also referred to the Model Bye-laws. Both these gentleman concurred as to the great desirability of these bye-laws, or something like them, being adopted by all local authorities. Opinions of course differ very widely on that point. I should, however, like to allude to a difficulty in the way of the adoption of the Model Bye-laws, which is perhaps rather a special and peculiar one, but which nevertheless, in some shape or other, prevents the adoption of these bye-laws in certain towns. The peculiar case to which I now wish to refer is that of a city where the corporation is not only not the sanitary authority, but the sanitary authority is almost perfectly distinct from the corporation. The sanitary authority is anxious to adopt the Model Bye-laws, with a few modifications. The corporation, as is nearly always the case, owns a large quantity of city property. The greater part of that property is closely packed, and the sites on which it stands are very small. Now if the Model Bye-laws recommended by the Local Government Board were adopted, and anything happened—as, for instance, a fire—by which the property was partially or wholly destroyed, it would be impossible for the corporation, under the Model Bye-laws, to rebuild that property. It has therefore happened that the corporation and other parties interested have, up to the present time, successfully resisted the adoption of revised bye-laws. Local authorities generally have been given to understand that it is very little use going to the Local Government Board with a set of bye-laws which differ very much from the Model Bye-laws. If that be so, there is little doubt that, in such cases as I have just named, no new bye-laws at all will be passed. I mention this difficulty (which may perhaps prove to be rather a serious one) in the hope that the Local Government Board may be induced to consider whether in some cases material deviations from the Model Bye-laws should not be sanctioned. Professor Robinson has given us a very concise and suggestive paper. With many of the points he brings forward and the opinions he expresses I entirely agree; but there are one or two from which I must dissent. First, there is the right of the "individual ratepayer" to appeal to the Local Government Board. That has already been ably disposed of by the President of that Board to-day. But, as a local surveyor, I should like to say that, if Professor Robinson had the misfortune to hold a municipal appointment instead of the distinguished position he so worthily fills, I am sure he would not advocate this right of the individual ratepayer. If the members of a local board do not, in the opinion of the ratepayers, act as they ought, they should be punished in a constitutional way, by being turned out at the next election; but the individual ratepayer certainly should not be allowed in every case to go directly to the Local Government Board, because he is ready to complain about everything in his district. If a manhole smells, or the roads are not repaired, cleansed, or watered to his entire satisfaction, the individual ratepayer is immediately ready to memorialise any board whatever, and he would interfere in the most trivial matters. No Local Government Board staff would be sufficient to deal with the business introduced by the individual ratepayer, and no president, however able and energetic, would in such cases be competent to direct the affairs of the board. With reference to the examination of local surveyors by the Sanitary Institute, I trust Professor Robinson does not expect this Association to believe that the possession of a certificate from the Institute would be a guarantee that sanitary administration, so far as it devolves upon the surveyor, would be satisfactorily done. I myself must confess to being extremely sceptical as to the value of any examination at all; and I do not speak without having had some experience. It so happens that I have had several men in my office who have passed examinations, and very stiff examinations too; but I should not be going very wide of the mark if I said that those men who had come out best in examinations almost invariably turned out to be of the least use in the office. This I can say positively, that those of my assistants who have never passed any examination, but have only passed through the ordinary pupilage in an engineer's office, were far more efficient and of far greater use. I trust no member of the Sanitary Institute will think from what I have said that I fail in respect for the Institute examiners, the motives which actuate them, or the value of their scientific attainments in many departments. With further regard to remedying defects in sanitary administration, something may perhaps be done by strengthening the position of the surveyor, who, I cannot help thinking, in the efficient discharge of his duties, is beset with great difficulties. In my opinion, however, the only true and permanent remedy is to educate the constituencies by which local boards are elected. When the public are sufficiently educated to conscientiously believe in the great importance of sanitary work, and to elect men to represent them on local boards, not because they are long-tongued advocates of political opinions of one kind or another, nor because they go in for economy at the cost of efficiency, but because they are really well fitted to look after the public health, then, and not until then, do I believe we shall get efficient sanitary administration.

Mr. **Lemon**: Mr. Angell has alluded to one subject which I think of very great importance, and that is the inspection of houses. I daresay you have all noticed letters which have appeared in the newspapers as to the evils arising from bad drainage in London and other towns. It so happens that my experience of this matter is peculiar. I have lived in London, and also in the provinces some years, and am now a member of a town council. Thus I can look at this subject from all points of view. I am very glad that the President of the Local Government Board has alluded to the inspection of houses in London, and to the position held in London by the so-called district surveyor and by the surveyor to a vestry. My experience in London has taught me that there is a conflict of authority there which must be got rid of sooner or later. The district surveyor is generally an architect in large practice, who is paid by fees, received by him direct, and these fees sometimes amount to a considerable sum. I know one case where the district surveyor received 2000*l.* a year. The district surveyor has only to carry out the Metropolitan Buildings Act; the inspection of the drains is done by the surveyor of the vestry. Thus between the two bodies you get what I call very inefficient supervision. The remedy I would suggest, and I wish to put it respectfully before Sir Charles, is that the district surveyor, as at present constituted, should be abolished; that he should be paid by salary and not by fees; that the fees should be paid by the builders direct to the Metropolitan Board, and that the officers appointed to carry out the inspection of houses should be one and the same person appointed by the district boards, and the work should not be left in the hands of separate persons. If that were done I am sure you would get more efficient inspection of houses than is now the case. I read a letter from a lady in the *Standard* yesterday complaining of the disgraceful state of her house drainage. In the town where I reside such a state of things would not be allowed to continue for a single week. The sanitary authority would direct a prosecution against the owner of the premises for having drains in such a state as the lady described, and which were clearly a nuisance detrimental to health. I merely mention this to show that the supervision in the Metropolis is not nearly so efficient as it is in the provinces. It is only by removing the dual authority in the Metropolis, which is very inefficient, that we can hope to improve the present unsatisfactory state of things. It is quite impossible for any architect in London to look properly after the erection of houses unless he has a large staff. If they were salaried, you could have not only a head of the department but also a number of assistants found, as at West Ham, to carry out the details under proper inspection. That brings me to the question of insufficient staffs. You cannot have an adequate staff because the ratepayers would object to the large expense that it would entail. My experience at Southampton, with regard to the inspection of houses, is a very curious one. When I was first elected, it took me two years to pass a code of bye-laws. Then I thought I was going to do a great deal, but I was deceived. I found that, although the Local Authority had passed the bye-laws, they would not give me sufficient staff to thoroughly carry them out. Although a certificate that a house was fit for habitation was to be given by me, I distinctly refused to do so, because it would have been a delusion and a snare, and not worth the paper it was written upon, because it was simply impossible for me, with my limited staff, to give that attention to the supervision of a building which I felt it was my duty to do. Therefore I declined to give any certificate, and I have never done so up to the present time. Lately I have been engaged on work in the rural districts, and there I find the difficulties are very much greater. I think the practice of allowing boards of guardians of the poor to act as rural sanitary authorities is utterly unsound in principle. The guardians of the poor have quite enough to do in looking after the poor, and should not be bothered with sanitary work. I found that, when the committee under which I acted sent up recommendations to the rural sanitary authority, they invariably left them to the end of the business, and then, as they did not wish to be bothered, put the sanitary business off until the next meeting. The result is that the work is very inefficiently done, and is left in the hands of the local committee, whose powers are very limited, and whose proceedings must be confirmed by the guardians. The result is practically that sanitary work is not carried out at all. I hope that any measure brought in to remedy these defects will take the form of a County Government Bill, and that county boards will be formed, which should have charge of the sanitary business in rural districts. I was much struck by the remarks of Mr. Chadwick. He alluded to efficiency of the Poor Law administration because of the extended area. If something of the same principle was applied to sanitary work, we should get rid of a great deal of the existing difficulty. We have an instance of that in the appointment of medical officers of health in counties. In many places the medical officer is the officer for a large area. I know a case where the medical officer of health is paid 800*l.* a year because different authorities have united together to appoint the same officer. The result is that the duties are better discharged, and the officer is more directly removed from parochial control. If such a scheme of local government comes to be carried out as has been foreshadowed by Sir Charles Dilke, and with the right of appeal from the smaller local authority to the larger one, I think that will remedy nearly all the evils from which we are now suffering. Then with respect to compensation, I think a great amount of evil results from the immense compensation paid to the owners for the removal of insanitary houses. I think the owner of a house in an insanitary condition commits an offence against the law and should not be compensated for the removal of such houses. I have known cases where persons have bought houses, knowing that they would have to be pulled down and that they would be compensated, and they have thus made a good thing out of it. Such a state of things should be promptly remedied, and I hope one result of the report of the Royal Commission on the Housing of the Poor will be that, instead of paying so enormously for the removal of slums, which is the great obstacle in the way of the present Act being carried out, landlords will be precluded from accepting rents for such ruinous premises.

Mr. E. **Pritchard**: Following as I do so many speakers, who have thoroughly discussed the various matters dealt with in the papers, there remains very little indeed for me to say. We have had three very important and instructive papers, dealing with subjects which we as Members of this Association have to consider daily, and there is a concensus of opinion by the authors that local government in its present state is in some way defective. There is no doubt strong objection to central government, and there are doubtless serious defects in the local government of districts throughout the country. I am of opinion that the qualification of officers, and the protection of officers, would be fully disposed of satisfactorily, if an arrangement were made, as already shadowed forth, whereby the area of districts would be increased, and county boards formed. Mr. Chadwick, who may be regarded as the pioneer of public sanitation, considers that there would be considerable advantage gained by increasing the size of districts. Mr. Lemon has referred to the way in which some rural sanitary authorities discharge their duties. There may be some which act in the slipshod manner described, but there are others which are just the reverse. I can mention several such bodies of which the Local Government Board has spoken in the highest manner. For instance, the Solihull Rural Sanitary Authority is far superior to most of the local boards around it. There, very great improvements have been effected, and there are examples where rural sanitary authorities have done good service in the administration of sanitary matters. Mr. Chadwick has alluded to the reduction of the death-rate by sanitation, and has spoken of the death-rate being reduced from 28 to 13 per 1000. It has also been suggested that in several rural districts most insanitary arrangements exist, and that the urban districts are not to be blamed, or at least not so much. The President has referred to one important town where there has been a serious outbreak, and as I have a knowledge of that town, and am at present professionally engaged in connection with that borough, with your permission I will briefly allude to it. That town is Kidderminster, where there have been some 700 or 800 cases of typhoid fever. When I tell you that no less than 120,000*l.* have been expended by the Corporation of Kidderminster in providing sewage works and water supply for the prevention of this very disease, it does appear very remarkable that in a very few years it should be placed in its present condition. There has not been any false economy in the expenditure of the money. Engineers may devise a good system, but if the requisite attention is not given to house drainage, as has been pointed out by Mr. Angell, difficulties may arise. In Kidderminster there are also slums, and many houses totally unfit for habitation. I would refer, Sir, to the passage in Professor Robinson's paper bearing on this point. I cordially agree with him that landlords should not be allowed to receive rents for premises that are totally unfit for human habitation. In Kidderminster there are houses close to slaughter-houses, the drains of houses are connected direct with the sewers without so much as a trap, and the sewers are without proper ventilation. Mr. Lemon has referred to London, the greatest city in the world, and looked up to by thousands of people as being as perfect in its sanitary arrangements as sanitary science can make it. He has referred to a case affecting householders, and Mr. Angell has alluded to a case nearer home—the official residence of the Local Government Board—where a most miserable state of things exists. When even Windsor Castle, the finest residential place in the country has been found in a similar condition—this shows the necessity there is for proper attention being given to sanitary matters.

Mr. Jerram: After the remarks made by the various speakers, I shall not now say much; but before I refer to one or two points, I wish to thank Mr. Angell for the way in which he has put several points of which I have been thinking for years, and for the interesting manner in which he has placed them before us. I think we are all agreed that, so far as urban sanitary authorities are concerned, one great evil is the smallness of the governing body. The majority of these bodies consist of nine or twelve members.

Unfortunately the members do not attend regularly, and when only three or four are present one prominent member controls the sanitary authority of a district. It is in such cases that a surveyor has most grounds for complaint. This man is often connected with jerry builders, has an unpleasant way of putting things, and practically rules affairs. It appears to me the only way of remedying this is to have a larger number of members. We do not hear of this occurring in corporations and larger bodies. It may be said that in larger bodies the work is done by two or three members, and that in such places as the Metropolis, one part looks after the sewers and another after the erection of houses; but when the work is thus cut up and divided amongst a number, one member has not so much power over his friends, and the surveyor can generally carry out what he believes to be best for the district. I hope that county boards will be established, and that we shall have larger districts and larger boards. But I do not think it should be so much a matter of county boundaries as of the physical conformation of a district. This difficulty crops up in the valley of the river Lea, and should be looked at and dealt with. If county boundaries are adopted, difficulties will only be increased from the geographical position of a district, whereas if the lines of a drainage area are taken, it would greatly facilitate drainage, and we should also have the advantage of larger bodies and larger areas. A good deal has been said about the examination of surveyors, and of protecting them in the discharge of their duties. Mr. Rawlinson has been quoted, to the effect that if a surveyor gets on badly with his board the sooner they part the better. Still it is very hard that a surveyor, when doing his best to carry out the work in his district, should be subjected to petty spite because he desires faithfully to carry out the Public Health Act in all its bearings. We know that this is so, and that sanitary inspectors can bear testimony to this, and to the difficulty they meet with from the tyranny of some person on the board. One thing urban surveyors require, which Poor Law officers possess, and that is superannuation. If a surveyor dies, or loses his life in the discharge of his duties, there is no provision whatever for his wife and family. The limit of age, as was recently the case at Chelsea, is often fixed at forty. When a man has to give up the whole of his time to his duties, and only receives a small salary, he cannot make that provision for his family which he ought to do, in the event of his dying or becoming disabled by disease. I think surveyors are the only public servants for whom some such provision is not made, and there should be in any new Act some provision for this, in the case of men who lose their lives in the public service. This is a matter which I think has not been sufficiently brought before this Association, and should be borne in mind by any one entrusted with the duty of drawing up amendments to the Public Health Act.

Mr. Gamble: I only wish to protest against the way in which the Sanitary Institute of Great Britain has been advertising to local authorities those persons who have passed its examination. I feel that I can with some grace take this step, as I happen to be one of those who have passed the examination. Still I think it is very unfair that others who are far more capable than I am, should, as it were, be put in the background by the Sanitary Institute attempting to dictate to local authorities whom they should have for their surveyors. With respect to the supervision of buildings, I was myself once sharply called to order by the chairman of a committee for acting too strictly in a matter in which he was interested.

Mr. Fowler: I, too, shall have very few remarks to make, as so much has already been said on the very able papers read, especially on that contributed by Mr. Angell, to whom we should all feel very much obliged. I knew when this Association was formed that it would come to the front and make itself heard. I am glad it has got so far as to bring these matters to-day immediately under the notice of the Government, through the President of the Local Government Board. I was one of the first who in some degree assisted Mr. Angell in the formation of this Association. The only two points to which I shall refer are, the economy practised by local boards, and examinations. The question of economy, I think, is not well understood by town councillors and members of local boards, who are supposed to represent the public. For instance, the first thing a town councillor does when he gets into office is to do something in the way of economy. In other words he tries to glorify himself: there is no doubt about that. When I brought forward the question of providing a destructor, at Newcastle, one member, with an enthusiasm of economy, said "That will never do; I can sketch you one in a few minutes which will cost much less." He did so, and his destructor was put up, but it would not burn the refuse from shops and my original plan has after all to be adopted. If you talk of economy in the strict sense of the word it is a very difficult matter to realise, because when you are sweeping or paving the streets, you do not know to what extent the advantages accrue in carrying out the work efficiently. For instance, in London or Manchester, how can you calculate the great economy which will arise through the saving of the wear and tear of horseflesh and vehicles? or in preventing the dust and dirt being blown into shops and destroying property? You never have it collated in any accounts, in any manner at all: the great advantages which would accrue from these two things. London is practically realising it by paving the streets with wood. The town councillor, when he gets into office, only thinks of this thing—What shall I do to convince my constituents that I am saving them money. Then with regard to the duties of the surveyor, they should be very clearly defined when such an officer is advertised for by a sanitary authority. If you notice the advertisements issued from time to time you will find that they are very vague and short, and rarely give a list of the duties the surveyor will be called upon to carry out. He has probably to take charge of the waterworks, to be the architect of all public buildings, and sometimes to manage a large estate producing extensive rents. All this is done for economy, and, besides these and other duties, the surveyor may have fifty or sixty committees also to attend in the month. How is it possible that he can attend to house drainage and scavenging, or to the men employed by the corporation, when his duties are so multifarious. The duties appertaining to his office should be defined under the Public Health Act, and it should be understood that if he does not do his duty under these heads he is at fault. But if duties are imposed which it is simply impossible for any man to carry out,—whether he has the right to appeal to the Local Government Board or not, the town council will not have the slightest difficulty in finding fault on one ground or another, because his duties are so numerous and varied. Now with regard to examinations, the greatest engineer that ever trod this earth was George Stephenson, to whom this country is deeply indebted for the advancement of science and the development of its great wealth. Now Mr. Grundy, in his 'Life of George Stephenson,' says that Stephenson rarely read a book, and when he was asked to be examined, I believe it was by the Institute of Civil Engineers, he said, "Who is to examine me?" There is no doubt that George Stephenson in carrying out his work had the assistance of men of theory, and his great brain applied that theory to his practical knowledge, and the result is, in fact, that we are here to-day. The Sanitary Institute of Great Britain is an admirable Institution in its way, and when I saw that it was going to take up the examination of borough engineers and surveyors, I thought I would go in for it; but I did not see any examiners, on looking through the list, that I should feel justified in going before. I thought, as George Stephenson said, "Who is to examine me?" After having carried out some of the largest and most important works outside of London, I did not think it was right that I should go to be examined by men of theory. I do not think it is right that they should set themselves up in this way. Then with regard to fees, the question of economy comes in again. If the fees were to go direct to the local authority, they might just try and see how many fees they could get and put the work upon their officers, and would say, we have made so much profit out of our officer, and bank the money to the credit of the rate.

Mr. Chadwick: Just one word upon the point of retention of office during good behaviour. An inquiry into the charge on which a surveyor is dismissed would be a great security. The result of that examination would enable him to vindicate himself before the ratepayers and others, and to refute any unjust charge. If, after an examination of that kind, he found that the public did not support him, then it certainly would be well for him not to hold his office any longer. If a surveyor were placed in such a position, I should certainly counsel him to resign. Such an examination might, I think, very well be taken before a county board. I might adduce some very good examples of administration of works. One of these is the administration of the roads in Ireland, by men of high and well tested qualifications. There the rates are administered by a county surveyor, and he is tested as to his qualifications by a central body of engineers. The effect has been that the roads in Ireland are maintained at nearly one-third less price, and with a saving of a fifth of the horse-power. I have calculated that if only one horse out of five is saved, it is a saving which would throughout this country amount to eight millions of money. It is the economy obtained by the qualification of the local officer that has brought about these results, which would save about eight millions annually in roads alone if it were introduced into England.

Mr. Angell, having been called upon to reply, said: I have very few words to say, because I think all that has been said by the various speakers who have discussed my paper has agreed with it. Two other papers have been read which touched several of the points, but evidently not out of harmony with mine. The two points most discussed have been, examination and protection. I have no very strong opinion respecting either. I have no objection to examination, but I do object to the Sanitary Institute putting itself forward as the examining body. The complaint against the Sanitary Institute is, that they drafted a charter of incorporation proposing to make themselves the examining body over us, and that the Institute has advertised in a certain way some people who have passed its examination. A suggestion has been made that the complaints of individual ratepayers should receive attention from the Local Government Board. The privilege of thus complaining is one that people are rather too fond of resorting to. Three days ago I had a very long letter from "My Lords" of the Local Government Board. Some man who had a personal feeling in a certain matter, wrote a very long letter of complaint to the Local Government Board. The Local Government Board copied that letter and sent it to my Board for their observations and remarks thereon, and there will probably be a long discussion about a trifling matter which could very readily be cleared up. A great deal of time is wasted, and much needless trouble is given in this way, and I think it is a very foolish thing. With respect to the remarks made by Sir Charles Dilke as to metropolitan surveyors, I was quite aware of the dual control which exists in London, and that it is very bad. Neither the district surveyor nor the local surveyor attends to certain matters, which between the two are never carried out. Of course building fees should not go to the officer, but to the board. Mr. Jerram advocated larger boards. My own experience has been totally against that. Large boards break up into cliques and the officer becomes a shuttlecock between them. Smaller boards, in my opinion, work infinitely better. I should certainly reduce large boards to a manageable number. My own Board is a comparatively small one. There are eighteen elected members and three delegated members to a population of 140,000, and the work is well done. The question of protection has been pretty well threshed out. The remark of Sir Robert Rawlinson had been quoted, that when an officer and his board disagreed, the sooner they parted the better. But I know this, that Poor Law officers are not frivolously attacked because members know that it is no use attacking them. On the other hand, if a surveyor offends a member, he threatens "to make it hot" for him, and he will perhaps continue his attacks and persecution for years. But if it were known that a surveyor was protected, that fact alone would prevent him being subjected to such treatment. The fact of being protected, protects against personal attack. It is very gratifying to have had this capital meeting presided over by so prominent a man in this country as Sir Charles Dilke.

Professor **Robinson**: The main points of my paper have not been discussed in a way that would show there is any disagreement between us. I observe with respect to protection, that you do not wish an objectionable or incompetent officer to be supported in his position against the wish of his board, but you desire to prevent a man being driven from his position by objectionable people. The very fact of having the right to appeal against such treatment would prevent such attacks, which if they do not get a man out of his office, render his position intolerable. With respect to the examinations of the Sanitary Institute, I merely mentioned that it is necessary to have some test for offices now held by very incompetent men. When I wrote these words I had not in my mind any one of eminence connected with this Association, whom I have the pleasure of frequently meeting. I was referring to a large number of persons who have to deal with health matters in small places. These people would never get into such positions if there was a proper test. Whether that test is applied by one institution or another does not matter, provided there is some effectual test. I do not agree with Captain Douglas Galton that the universities should be the tribunal. I would prefer that it should be composed of members selected from two or three societies. I am a member of the Sanitary Institute, and like Captain Douglas Galton one of its examiners, but I had no intention or desire to get into conflict with the Members of this Association. The object of our meeting here, and of my writing my paper was the same—to get information; and the main points I put forward in my paper I still hold, and the consensus of opinion to-day is in favour of them. I hold there should be some examination as to fitness, and that an officer should have some right of appeal against arbitrary acts of an authority. Local boards are very often composed both of unfit people and of persons who have interests opposed to the interests of those amongst whom they live. The result is that the life of any zealous, competent and conscientious surveyor is rendered perfect burden to him. He cannot carry out works which he feels he ought to do, and he feels all the time that he brings down some one upon him who can deprive him of his position, and of his bread and cheese. I desired to direct attention to the position in which men were thus placed, and I hope Sir Charles Dilke will introduce into the next Bill dealing with the Public Health Act some such protection for the officers of local authorities.

Mr. Boulnois: I must apologise for not being present to read my paper myself, but unfortunately my train was late and I could not arrive in time. I should like to say a word respecting the examination of the Sanitary Institute, as I have passed that examination myself. I think anything which will raise the status of the surveyor throughout the country is a thing which ought to be encouraged, and it was with that object that I passed the examination. Whether the Sanitary Institute is the proper authority to hold such examinations I will not say, but some such examination is very desirable. Anything which would give us additional status, or make local boards look upon us with a little more respect, should be strongly encouraged.

The President: In rising to close this very interesting discussion, allow me first to say how very pleased I am that this meeting has proved such a success. I should like just to say a word upon protection, and I trust you will not think I am the devil's advocate if I take the other side of the question. I look with very great distrust upon the idea of calling in any other authority to protect us. I think it might be a case of exchanging King Log for King Stork. No one who does his duty, properly and fearlessly, will ever want proper support. In fact, to put it in two words, no man who is worth his salt will ever have any difficulty in getting his bread and butter.

REMOVAL OF HOUSE REFUSE.

By ROBERT GODFREY, Surveyor to the King's Norton Rural Sanitary Authority.

In a report "On the Systems in Use in various Northern Towns for Dealing with Excrement," made by the late J. Netten Radcliffe to the Local Government Board in 1869, there is the following paragraph:—"The propagation of certain epidemic diseases, especially cholera, enteric fever and diarrhœa, among communities, as the result of excremental pollution of air and water, is one of the best-established facts of sanitary medicine. It is a fact which has been admitted for over a century, and still various inquiries of this department (themselves affording repeated evidence of its truth and importance) are showing that it remains without practical recognition by a large proportion of the health authorities of the kingdom. It must be allowed that this inaction has been mainly due to the ignorance, or the parsimony, or the carelessness of the bodies to which sanitary matters have been intrusted. Certain authorities have been glad to have—as a handy excuse for delaying to take any steps whatever towards amendment— the want of agreement throughout the world as to the means of amendment." After a lapse of fifteen years this heavy indictment against local authorities retains much of its force. The larger towns, such as Manchester, Birmingham, &c., have spent large sums in attempting a solution of the difficulty; but what by comparison has been done by the smaller communities? The "ignorance," "parsimony," and selfishness of the poor ratepayers' representatives have in very many instances effectually prevented the adoption of *any* scheme of systematic removal. The social position of many of the members of small local authorities is such that progress is impossible. When a waiter at an hotel at a seaside resort is chairman of the local board, what can be expected? What encouragement has a surveyor to devise schemes which will ultimately benefit the whole of his district? In his present position the surveyor is often at the mercy of almost any clique which smoke-room or tap-room oratory can raise, and it is in the smaller communities that his services in the present day are most needed and least appreciated.

A careful study of the Model Bye-laws, and a close acquaintance with the arrangements for house-refuse removal in many places such as most of the Members of this Association possess, cannot but lead to the conclusion that the principles on which those bye-laws are framed is the correct one. The difficulty is in applying the principle there laid down to the multitudinous variety of circumstances which present themselves. No hard-and-fast line can be drawn; nor would such be desirable. But in the interest of all, the importance of small accumulations and frequent removal cannot be too firmly insisted upon.

The circumstances of the present day are so widely different to those of a quarter of a century ago, and the average local board member is a being of such slow mental growth, that it is almost impossible to bring him to see that what was passable in his youth is not permissible now.

The Act of 1848 which gave such a great impetus to sanitary work, and directed the attention of thinking men to the evils which existed in our midst, did not succeed in grasping the whole subject; and though from that date the water-carriage of fæcal matter has made rapid progress, still there are many places which are in the same condition as they were prior to the passing of that Act.

The removal of liquid filth by the sewers is not the unmixed benefit which is claimed unless refuse removal is systematically carried out at the same time. There has been undoubted improvement in the public health, but this improvement could be further increased if local authorities were compelled to complete the work of which sewerage is only one moiety, and to undertake the systematic removal of house refuse.

The old cry against "raising the rates" will be raised, but that must be faced. Sewerage works which do not succeed in abolishing the filthy pit, mixen, midden or dumb-well are incomplete, and where a water-supply exists no difficulty ought to be experienced in so doing. Yet in how many places does the old privy reign in all its rampant impurity. Deep holes in which liquid filth is allowed to accumulate are far too common, and no provision is made for the safe removal of their contents.

The affection for the old-fashioned bog is marvellous, but sanitary authorities are neglecting their duty when they do not seek by every means to abolish it.

From the replies which have been received to a few questions addressed to some of the Members of this Association, it seems that in very few (27 out of 74) is there any *maximum* size of pit. While in one or two instances there is a *minimum* permitted, one being 50 cubic feet and open.

The connection of pits with the sewers is now fast becoming a thing of the past. In the early days of sewerage it was looked upon as a *sine quâ non* that the sewers were to remove all the liquid contents of the privy, but it is now generally admitted that such connection was a mistake. Mr. Netten Radcliffe's discoveries in Manchester, and the experience of many Members of this Association, revealed a state of things which was doing more to neutralise the effects of sewerage works than anything else. Few are drained into the sewers (16 out of 74), and many places have seen the futility of it and are disconnecting as fast as possible.

The plan of covering them is making very rapid progress. In the majority of districts from which answers have been received covering in is insisted upon (56 out of 74).

The introduction of a system of sewers into a town, whether with or without a water supply, is gradually forcing upon local authorities the necessity of attending to the removal of what the sewers leave behind. The introduction of artificial manures among agriculturists—the facilities afforded for the transport of such manures by rail—the independence of farm servants, who often refuse to work at night—and the large importation and consumption of canned food, all go to make the duty of the local authority more imperative to undertake the complete and systematic removal of refuse, more especially is this the case where the water supply is from wells. The amount of pollution which takes place in those districts where the only potable water is derived from wells is incalculable, and it is in such places that it is more than ever incumbent on the local authority to rigidly control the accumulations which poison the air in confined yards, and pollute the water supply.

The amount of ground covered by the open wet privy-pit is something enormous. In one borough of 13,000 people there were 10,000 square feet of surface covered with the most pestilential breeding filth, and in Birmingham in 1871, when the population was about 350,000, there was an area of 13½ acres so covered. If every local authority would obtain a return of the space within their districts which is hourly polluting the air we breathe, such a state of things would be revealed as would astonish them, and rapidly bring about a total abolition of the pit system.

The policy of sewage enunciated at Manchester ten or eleven years ago, was all very well in its way, but a policy of scavenging is of equal or even greater importance.

Many of our local authorities provide a good water supply and a sewerage scheme, and avoid the equally important duty of removing all filth not removable by water from the district.

In the Midlands and the North of England, the big pit is still common, and until pressure from the central authority is brought to bear it will die a lingering death. The time is coming, and rapidly, when every community must have the means of destroying the thousand and one unconsidered trifles by fire. We are slowly arriving at a state when *water* in purity and plenty is the common right and possession of everyone. But when shall we say the same as to *air*, which is of equal importance to the health of our working populations! Never! while the privy is allowed to remain in its present condition.

The more the water-carriage of fæcal matter is developed, the more difficult it is to deal with the house-refuse which remains. The farmer will not fetch the contents of the dry ashpit, nor purchase it if carted to his farm, the occupier is helpless to remove it, and in the public interest the local authority must grapple with the question, and in view of the value of land, which is either building land or accommodation land, the practice of sending it all away to "Tips" must come to an end, and the sooner the practice is abandoned the sooner will the death-rate be reduced and infant mortality largely decreased.

The "Destructor" is the natural complement of every sewerage scheme, and until it is included in every such scheme, the "Tip" must increase in offensiveness and danger. There is a great opening for some Member of the Association to bring out a destructor which shall command the market. The Burnley "Beehive" is having a trial, and its cost seems to be light compared with an eight-cell destructor, including land wall and all appliances, now in course of erection at West Bromwich, at a cost of 6,000*l.*, to deal with the refuse of a population of 56,000.

The average member of a small local authority cannot see the necessity of a Destructor unless for very large populations, "What has done, may do" is the maxim which too often guides his decision; and not until some great calamity occurs does he awaken to the necessity of providing for the increasing valueless rubbish which accumulates. Heckmondwike (9,282), Buxton (6,025), Bournemouth (16,858), Ealing (15,764), Richmond (19,066) with many others, are using Destructors. Coventry and Oldham, are thinking of erecting them. Stoke-on-Trent must have one shortly, and Birkenhead and Blackpool have one nearly finished. Leicester is experimenting. Batley, Bradford, Worcester, and Cambridge are considering the necessity of adopting some means of carbonising the dry refuse, and if the claims of the "Beehive" are substantiated it seems to offer a satisfactory solution of the difficulty as regards cost, the estimate being 70*l.* per cell, without shaft. The annual cost of maintenance has not yet been clearly ascertained, but if, as stated in the Richmond experiments, one ton of ashes and half a ton of excreta were destroyed in seventy-five minutes, the cost cannot be excessive.

In dealing with the refuse, some attention must be paid to the sentiment of the inhabitants, and however perfect, theoretically and practically, the routine of the "pan" system may be, there is a powerful dislike to seeing vans parading the streets in the daytime. Manchester has had to give way to popular feeling, and during the busy hours of the day the vans are not allowed to pass through the populous parts of the city. The proper time for removal is night, and not after 8 A.M. To the casual passer-by the sight of one of these vans engenders a feeling of disgust and often nausea, and local authorities who adhere to the night for removal certainly show more consideration for their constituents than those who have it done in the daytime.

To bring about a satisfactory system of house-refuse removal, the following must be the cardinal principles:—

1. Small accumulations;
2. Frequent removal;
3. Separation of fæcal matter from house-refuse;
4. Carbonisation of all worthless matter.

The Local Government Board in its Model Bye-laws has the first two of these fully in view, and very reluctantly consents to the enlargement of pits beyond 20 cubic feet. In Bournemouth and Wanstead, 6 cubic feet is the rule, West Derby 27 cubic feet, while some permit an area of 20 to 30 square feet, with depth unlimited. But the difficulty of getting health authorities to adopt these principles is sadly obstructive of really good sanitation.

Frequent removal is gradually forcing its way to the front, and it is to be hoped that ere long every local authority which has not adopted it will be brought to see the importance of it.

The separation of fæcal matter from worthless refuse is a matter of the greatest importance, and must eventually become general, and a good pit which will provide for such separation is a great desideratum. The Manchester plan is one of the most effectual, but not always easy of adoption; and the Rochdale system has its advocates.

Where there is plenty of room in the rear of houses, removal once a month would be ample. It may be taken that the denser the property dealt with the more frequent must be the removal, not more than weekly; but with villa residences, such as pertain on the outskirts of many of our large towns, a monthly removal is sufficient.

The adoption of the principles above enunciated means a wholesale reconstruction of existing pits, and the tedious routine of the Public Health Act renders such reconstruction exceedingly difficult. In towns which can afford the luxury of a special Act, proceedings can be taken with facility, but in ordinary towns what a crop of difficulties arise, and until some general measure is framed the task of reducing pits is one of extreme difficulty. Having to treat each one as an ordinary nuisance under section 91, Public Health Act, is a fearfully slow method of procedure.

It would be valuable to students of sanitary science if a Parliamentary return on scavenging was moved for and obtained, showing how the matter was dealt with and the area of ground covered, in every urban district in the kingdom; many a return of much less value has been obtained by crocheteers, and this ought to be procured.

Where the privy-pit must exist, and there are many places where it is unavoidable, it must be shorn of its terrors by—

1. Making the bottom tight and 3 inches above the ground level, so as to detect leakage and prevent it being used for slops;
2. Constructing it so that it will not hold more than four weeks' accumulation;
3. Separating the fæcal matter from the rubbish, viz. cans, cabbage-stalks, *et hoc genus omne*;
4. Roofing it (but not boxing it up) and ventilating it;
5. Providing for discharge of ashes on fæcal matter;

6. Constructing it so that access can be had by the night-men without the intervention of the occupier;
7. Relieving both owner and occupier of all responsibility as to removal of contents.

When the separation of rubbish from fæcal matter is accomplished, the latter is improved in value and will be gladly used by the farmer, and the former must be dealt with by the destructor.

The 42nd section, Public Health Act, wants amending by the excision of the words "*may and when required by the Local Government Board,*" so that it should be compulsory on every local authority to do the whole scavenging.

Every village should have its night-soil man responsible to the local authority and under the orders of the inspector of nuisances. It is absurd to have to go through the routine of the Public Health Act in order to get a pit emptied, besides being a great waste of time and energy, which could be more advantageously employed if the inspector had power to order the removal of the contents of a pit as soon as full.

The subject of the cost of scavenging is a very wide one, and no returns are available which would afford any clue to the best method to be adopted. A Table is appended, showing the cost per head in a number of towns taken promiscuously from the list of those represented by Members of this Association, and the thanks of the writer are due to those gentlemen who so kindly furnished him with replies to the queries sent out.

Name of District.	Population (1881).	Cost per head.	How removed.	Remarks.
		d.		
Buxton	6,025	3·1	By Local Authority	Destructor in use.
Ipswich	50,546	4·0	Ditto.	
Prescot	6,419	4·1	Local Authority empties, farmers cart away.	
Worksop	11,625	4·1	Local Authority and Contractor.	
Bridlington	8,343	4·7	Contractor under Local Authority.	
Bedford	19,533	4·7	Contractor.	
Bingley	8,972	5·3	Ditto.	
Warwick	11,800	6·1	Local Authority.	
Coventry	42,111	6·2	Ditto	Thinking of a destructor.
Carlisle	35,884	6·3	Contractor.	
West Derby	33,614	6·7	Ditto.	
Wednesbury	24,566	6·8	Ditto.	
Derby	81,168	6·9	Local Authority.	Destructor in use.
Redditch	9,961	7·3	Ditto.	
Whitehaven	19,295	7·8	Ditto.	
Newton in Mackerfield	10,380	7·9	Contractor.	
Boston	14,941	8·1	Local Authority.	
Hanley	48,361	8·4	Ditto	Thinking of a destructor.
West Bromwich	56,295	9·0	Ditto	Erecting a destructor.
Harwich	7,842	9·6	Ditto.	
Withington	17,109	9·6	Ditto.	
Stretford	19,018	10·0	Contractor.	
Rotherham	34,782	11·0	Local Authority.	
Great Grimsby	28,503	11·5	Contractor.	
Stoke-on-Trent	19,261	12·7	Local Authority and Contractor.	Must have one shortly.
Toxteth Park	10,368	13·3	Contractor.	
Rhyl	6,029	13·7	Local Authority.	
Southport	32,206	13·8	Ditto.	
Crewe	24,385	14·1	Ditto.	
West Hartlepool	12,361	14·5	Contractor.	
Goole	10,418	15·1	Ditto.	
Birkenhead	84,006	15·7	Ditto	Erecting a destructor.
Bury (Lancashire) ..	52,213	16·0	Local Authority	Destructor in use.
Blackpool	14,229	16·9	Ditto	Erecting a destructor.
Leicester	122,376	17·5	Ditto	Experimenting on destructor.
Benwell	4,893	18·6	Ditto.	
Burton-on-Trent	39,288	21·2	Ditto.	
Oldham	111,343	23·6	Ditto	Contemplating "Beehive."
Rochdale	70,000	27·4	Ditto	Destructor in use.

DISTRICT MEETING AT LEYTON.

October 10th, 1884.

Held at the Town Hall, Leyton.

Mr. W. G. Laws, *President, in the Chair.*

THE LEYTON SEWAGE WORKS.

By W. DAWSON, Surveyor to the Local Board, Leyton.

The Leyton Local Board district is about 2500 acres in extent; it is bounded on the north by Walthamstow, on the south by West Ham, and on the east and west by Wanstead and Hackney. The population is now about 35,000. In 1841 it was only about 4000. The rateable value in 1841 was 2000*l.*; it is now about 160,000*l.* Mr. Bailey Denton, in a report to the Board, dated October 1879, just four years ago, says so rapid has been the increase of the population in Leyton during the last twenty years, having risen from 7536 in 1867 to 15,506 in 1871, with a further increase up to about 20,000 at the present moment, that the provision for the future must be more than ordinarily liberal. Looking forward to fifty years, it is not in any way an extravagant view to assume that in that time the population of your district may amount to 50,000 people; and if we take the consumption of water at 25 gallons a head, the sewage proper to be disposed of will then reach 1,250,000 gallons per day. This is copied from Mr. Denton's report; and now, only four years after that report was made, our population is nearly 35,000, and our sewage flow is quite one million and a quarter gallons daily.

Previous to the erection of the works I am now about to describe, the drainage of the district was treated in two different sets of tanks, or filter-beds, designed by Mr. Ashbee, the late Surveyor of the Board; one set for Leyton and one for Leytonstone, the sewage being filtered through straw and charcoal. The sludge was allowed to accumulate until dry, and then carted away and put on the land. These tanks continued in use until last year; but, although answering the purpose at the time, they were not so satisfactory as the district increased.

In 1879, Mr. Denton was called in, and advised the Board to adopt a modified sewage farm—that is, he recommended, with limited tank arrangements, the purchase of a sufficient area of land, not less than 40 acres, for the cleansing of the liquid sewage by intermittent filtration, and thus save all payments for special chemicals or royalty, if any patented process was adopted. This report, I believe, was accepted by the Board; but shortly afterwards there was so much opposition from the ratepayers and the public generally, that the motion was rescinded, and the Board decided not to establish, under any circumstances, a sewage farm within the limits of their district.

This decision brought another report from Mr. Denton, in February 1881, recommending chemical treatment, and bringing four different processes under the notice of the Board. 1st. The Native Guano Company's A B C process—alum, blood, and clay. 2nd. The Rivers Purification Association--sulphate of alumina. 3rd. General Scott's method—lime. 4th. Hille's process—lime, tar, and salts of magnesia. He also submitted a scheme for chemical precipitation, supplemented by land for filtration. The Board, before deciding upon any of these processes, resolved to visit the various places where those schemes were in operation, and, after many visits to different places, the process of the Rivers Purification Company, in operation then at Hertford and Coventry, pleased them most, and, after consulting with Mr. Denton, Mr. Mellis, the engineer of the association, was engaged to prepare plans and estimate, and an estimate was also obtained of the terms in which the Rivers Purification Association would undertake to treat the sewage of the district for a certain number of years. Mr. Mellis's plans of the works were approved by the Local Government Board, on December 20th, 1881, and shortly afterwards, June 1882, the works were put in hand, Messrs. Ford & Everett being the contractors for the tanks and buildings.

These observations, as far as I am concerned, are matters of history, not having been appointed surveyor to the Leyton Local Board until March 1882. However, I am glad to see several members of my Board present who will correct me if I am wrong.

In October last the works were opened by the Rivers Purification Association, under a three years' contract with the Board, and they continued to work them successfully up to the 19th July last. The expense involved in the treatment of the sewage by this company was certainly double the annual payment they received. This, of course, could not last, and after several unsuccessful attempts had been made to treat with the Board, the company stopped the works on the 18th of July. I then commenced to treat by the same process, which is, as you are aware, lime, sulphate of alumina, and copperas and I found, as the company had done, that to procure a fairly good effluent entailed a serious expense.

I had heard a good deal of the process carried on by Mr. Hanson, at Aldershot, and, after visiting the works, I resolved to make a trial of the black-ash waste. After many experiments, before arriving at the different proportions of lime and black ash, I think I have now, with from 16 cwts. to 1 ton of lime, and from 3 to 4 cwts. of black ash per million gallons, secured, as you will shortly see, a fairly good effluent, certainly free from smell, which I consider a most important matter, which I never obtained by the alumina process, although it is sometimes not quite so clear. However, I am glad to say Major Flower, the able Engineer of the Lea Conservancy, has reported very favourably upon the character of the effluent, and as long as we continue to give him satisfaction we may be satisfied.

Our normal flow of sewage is about 1¼ million gallons in the twenty-four hours; of that we treat a little over one million gallons, and the 200,000 gallons of untreated sewage flowing into the tanks between 10 P.M. and 4 A.M. is so weak and diluted that the tank which receives the night's flow is always the sweetest in the morning. I may say the principal amount of sewage flows into the tanks by gravitation, only 250,000 gallons requiring to be pumped, this is done about twice a day.

The sewage, on entering the works, is screened as described below; it then receives its proportion of lime, which I get from the Claycross Company, Ambergate. This I consider the best. The lime is mixed in two vats, each containing 800 gallons of water with 2 cwts. of quicklime. We generally use about ten vats in the day. While one vat is discharging the other is mixing. After it receives the lime it flows into the mixing chamber constructed underground, where the sewage and milk of lime is thoroughly mixed by a pair of agitators. It then flows on until it receives the black ash, which is mixed in two vats, each containing 1000 gallons of water. We use about four vats in the day, each containing about 1 cwt. of black ash. It is then agitated in a similar mixing chamber to that of the lime; it then flows right into the tanks. All the water used in the works, both for machinery and chemicals, is the effluent.

And now, sir, just a word upon the presses and the disposal of the sludge. We have Johnson's presses, and I may say, in starting, that the working of them has been eminently satisfactory in every sense of the word; indeed, I do not see how we could do without them, unless we adopted Mr. Jones's process, so successfully carried out at Ealing; but the presses I believe to be better and cleaner. Whether the sewage cake or the pressed sludge is of any value as manure or not, I am glad to say that it is all removed free of cost as soon as it is made; we have even some competition for it, and I believe eventually we may get a price for it. Through the kindness of Messrs. Johnson I shall be enabled to submit a sample of our sludge to Dr. Munro, who intends to apply it to the land for experiments in contrasting it with the results obtained from farmyard and other manures, and I shall be glad to communicate the results of these experiments to the Association.

But the pressing is, of course, a serious item in the expense. Mr. Johnson states in his pamphlet, which I only saw last week, that the presses there described will suit a population of 30,000. If most places in proportion get anything like the amount of sludge we get, I should say start with a double set. We commenced with a double set of presses, containing 25 plates each, and we have already added six plates to each, and reckoning a little under ½ cwt. to each plate, the average weight of a well charged press should be 15 cwts. We are now working them about 14 hours each day, and getting about 15 tons of pressed sludge per day. The amount of pressed sludge returned by the company for some weeks before the stoppage was something enormous, the average for the last three weeks being 160 tons of pressed sludge—one week 173 tons, representing 865 tons of sludge. The amount fairly staggered me. The presses were then working night and day; the quantity was obtained by counting the number of presses and multiplying that by the estimated weight of the press. Observing when the presses were being cleared out a great difference in the bulk, I resolved upon weighing each press separately, so rigged up a weigh-bridge and started the following morning, and the result was surprising. I found the lightest press to be about 8 cwts. and the heaviest about 16 cwts.

You must remember that the men are paid piecework, at so much a press, so that in reality we were paying the same amount for pressing 8 cwts. as we did for double the amount. Observing the presses closely the following day, I found I could easily distinguish a light press from a well-filled one by the quantity of water dropped in straining, On opening these presses I found always some obstruction in the shape of rags, corks, &c. My attention was then directed to the better straining of the sewage, and I could account to some extent for the enormous amount returned by the company. The large extractor wheel, which had never done its work properly, and which cost over 300*l.*, I stopped, and fixed up a proper strainer at the entrance to the mixing chamber, and the result was doubly satisfactory. First of all I saved 3 cwts. of coal per day, and I got ten times the amount of solids and other gross matters than that kept back by the wheel. The solids are cleaned by hand with a rake, made to fit the strainer, and I have now a sludge perfectly free from even paper, and I get a properly filled press upon every occasion; and that also greatly assists the effluent. So that as far as my short experience goes, I should advise any one about to use the presses to be most particular in the straining of the sewage, otherwise you will not get a properly filled press.

Another matter that should be attended to is the cloths. Always have three sets in use and change them every week at least, and have them thoroughly washed and dried. The cloths which were in use by the company when I took to the works, and I have had a new set of the same material since, cost over 11*l.* per press, and they did not last over five weeks, so that at that rate the cloths cost over 4*l.* per week. Messrs. Johnson have since given me a pattern of a cloth which I hope will last as well, and will cost less than half the money, but at any rate you may reckon that the cloths for a double set of presses of thirty plates will cost at least 100*l.* per annum.

I forgot to say we are bound to add lime to the sludge before it will press. We put nearly ½ cwt. of lime to each press. This is emptied into the sludge tank and mixed before the sludge gets into the receivers. I have heard of nothing to facilitate the pressing but lime; without it the sludge will leave the presses in nearly the same state as it entered. I have tried sand, ashes, gypsum, soot, black ash, sawdust, but all to no purpose. Nothing but lime will do, so that also is an additional expense.

The plates of presses must also be kept thoroughly clean, as at times the mud gets through the cloths and then dries on the plate, filling up the grooves and preventing the straining. A short length of indiarubber hose and a nozzle should be provided between the presses, so that the plates could be washed down when necessary. Steel wire brushes should also be used for cleaning the plates. These are made by Selig, Sonnenthal & Co., of Queen Victoria Street, and I find them very useful.

If you have your effluent course lined with enamelled bricks, these brushes can also be used to keep that clean, as the quantity of lime used in the process tends to leave a deposit on the bricks, and makes your water look bad.

We have four tanks, each about 150 feet by 60 feet, containing 250,000 gallons, all working independently, having opposite each a penstock connected to the treated sewage channel. We generally have three working while the other is being cleared out. The sides and walls are formed of cement concrete, in the proportion of six to one, faced with and coped with Staffordshire blue bricks, three stretchers to one header, all laid on flat in cement mortar. The bottoms of tanks are of concrete, one foot in thickness, and rendered in cement mortar, three-quarters of an inch in thickness, in the proportion of three to one. The tanks are emptied by means of a floating arm in each, that reduces the water to within about a foot of the sludge. There are then two 6-inch sluice valves, through which it flows into a sump, and is afterwards pumped back into the works and is re-treated. After the supernatant water has been cleared the sludge flows into a channel, from there into a sump 20 feet deep, 4 feet 6 inches by 4 feet 6 inches inside dimensions, and thence it is pumped up into the sludge tank, where again so much of the water is strained off back into the sewer, and gets re-treated. The sludge, after getting its proportion of lime, flows into the receivers in the press-house by gravitation, and from there into the presses, where it takes about one hour and a quarter before it is properly pressed. It takes two days to clean out a tank, so that each tank is cleared out every eight days. The cost of the works is as follows:—

	£
Land, 12 acres, about	7,000
Tanks, buildings, and machinery	14,700
Cottages for men	900
Fencing and laying out land	400
Total, about ..	£23,000

DISCUSSION.

Mr. **Lewis Angell**: I have not had the advantage of hearing Mr. Dawson's paper, but I am tolerably familiar with these works and have been so for a considerable time. It is much to the credit of the Leyton Board that they have put up such very excellent works, and it is also much to the credit of Mr. Dawson that he has displayed such energy and knowledge in his charge of them. I have had occasion several times to go and inspect the works, in what perhaps might have been considered an antagonistic manner, having been retained by the Duke of Devonshire to watch them with regard to the Lower Thames Valley sewage question. There is a distinction to be made between what is suitable for a place, and what is absolute perfection. Unfortunately, the companies and patentees always claim absolute perfection for the schemes which they bring forward. That was so with the scheme worked by the Rivers Purification Company. It might have been good for a place, and quite sufficient for the volume of water; that was to say one thing; but to say that it was an absolutely perfect scheme, and that an effluent could be got which would stand the test of analysis, was quite another. On many occasions I took samples of the water, and found it clear and nice when it came out, but when I had had it bottled up for three or four days, according to the temperature which prevailed, it was as foul as it could possibly be, a fungoid growth had commenced, and secondary decomposition had taken place. That was the condition of things which was going on at Leyton before Mr. Dawson took charge of the works, and I am prepared to say that the bottled effluent was as offensive as it could possibly be. I had the analysis of these samples, and was prepared on oath to show the results. This had been done independently, and merely to find out the effects, and I was prepared to swear to the results of this sample; yet, at the same time, the results given by the chemist employed by these works was that the effluent was absolutely pure and fit to drink, and that there was no secondary decomposition. That was a conflict of evidence! So far as I could see to-day the condition of the water was extremely satisfactory, and the condition of the water sent over the lip was exceedingly clear. I do not know the chemical result, but think it could not possibly do harm in going to the river below considering the large fall of water. That is what a Board like Leyton and the inhabitants and ratepayers have to look to. One rather amusing incident occurred at that time; I heard that Leyton was pouring into the river a foul offensive sewage, blackening the water, so I went to see what was really taking place. I found unmistakable sewage going into the river, and followed it up to the Leyton works, thinking I had convicted them this time, but I suddenly found this line of offensive sewage turn off to the right, and very clear water was coming from the Leyton Works, adulterating the sewage. The results of to-day you have seen and can judge for yourselves; I should say it was a fair result and quite sufficient for the requirements. Leyton has been at very much trouble, for they were in a peculiar condition, being a very apt illustration of the Parable of the Unjust Steward. There was West Ham down below with rather a big thing on their hands, and it was complained of; but I must not say too much in the presence of Major Flower—at all events they had been complained of, and they had been trying to satisfy Major Flower, who I believe is living in hopes of their future conduct. Leyton had been a great offender against West Ham some years ago, it was sending its sewage there, and after they (West Ham) had been forgiven they turned round and took Leyton by the throat and got an injunction to restrain them; Leyton having been forgiven, they in turn took Walthamstow by the throat, and obtained an injunction. It was a pretty triangular duel, and I do not know how these things will be settled. Great credit, however, is due to Leyton for the excellent works they have put up, and I am certain that they are endeavouring to do their work satisfactorily.

Major **Flower** (Lee Conservancy): I hardly like to say much, because anything that I might say would probably be taken as an expression of the opinion of the Lee Conservancy Board. I would, however, begin by saying that whatever I have to say will be my own opinion. Mr. Angell has alluded to complaints of West Ham, but I do not want to throw one town against another, or act in any way than as a fair judge of this considerable watershed. With regard to Leyton, I too was retained by the Duke of Devonshire in opposition to the scheme for treating the sewage of the Lower Thames Valley by the same system as that which had been adopted at Leyton. It was proved that the system was not good enough for the treatment of the sewage of the Lower Thames Valley, nor for the treatment of sewage at Leyton, inasmuch as after the effluent had left the works it set up a foul condition of affairs. I am considered to be the author of the term "secondary decomposition," but I believe every chemist knows that such a thing does take place. From what you have seen to-day, I think all will acknowledge that a fair result has been arrived at. I should be glad indeed if every town in the watershed below the intakes of the water companies had as good a result to show. I have been down here in hot, cold, and wet weather, and have seen the treatment of sewage by other processes, and have found it exceedingly good at times and exceedingly bad at others. I saw it the other day, but did not find Mr. Dawson at his office; I wrote to him that there was a vast improvement. I have been asked at my own Board whether I have sanctioned the treatment of sewage at Leyton as being all right, but I denied having written or said anything of the kind. I wrote to Mr. Dawson that there was a vast improvement and that at that moment I had not the slightest fault to find with the treatment of the sewage at Leyton.

Mr. Fowler: I have constructed some of what were perhaps the largest precipitation works in England, and therefore I have some knowledge of the subject both from experiments which I have made and from the very large sums of money which different corporations have expended to bring the results at all approaching the standard of purity set up by the Rivers Pollution Commissioners, which it is well known is too high a standard to be reached with the present knowledge either of engineering or chemistry. What we have seen this morning has pleased me immensely. Some twelve years ago the Corporation of Leeds had an injunction imposed upon them to restrain them from discharging their sewage into the river Aire, though at that time it was a stream so dense and black at its junction with the Calder that the Rivers Pollution Commissioners, by way of expressing their opinion and to give a fact which should be beyond dispute, wrote a memorandum on the waters of the Calder; this was registered in their Blue Book, so that I think it was very hard that the Corporation should have been restrained from using the main sewers for the time being. However, they set about to put their house in order; they visited almost every town in England, and spent 10,000*l.* in experiments, and then set to work after that to construct tanks. The works which I designed, and partly carried out before I left Leeds, are at work to this day. Lime only is used. They had several squabbles with patentees and different parties who claimed great things. They advertised to all the world, and gave up their works for a certain period for experiments, the results of which should be judged by the minimum amount of sludge and the brightest effluent. I believe Mr. Hanson experimented there and that the results were very good indeed, but Leeds being an economical town I do not think they were wishful to go to any large expense in getting a very bright effluent, so seeing that the river was still very black, they went back to lime, which they are still using, and which they have been using for some years at the rate of one ton of lime to a million gallons of the effluent, which effluent is nothing like that which we have seen to-day. There is one great advantage in what we have seen this morning as there is an almost entire absence of smell; lime, on the contrary, sets the ammonia free, and of course there is a smell. The germs of typhoid fever which flow in the effluent water is such a serious matter that it behoves every corporation, whatever process of precipitation is adopted, if possible to pass it over land and thus have it still further purified before it goes into the stream, for though it may be bright and free from smell, still there are germs in the effluent water which may sow the seeds of typhoid fever. Sewage may be turned into a river comparatively pure and able to stand the test of analysis, and in analysing the water of the river you may take 360 samples of water in a can dropped over the parapet of a bridge into the middle of the stream and not take up any of the germs which are floating there, but at the end of the year, after taking these samples, the very last one may contain the dangerous germs of disease; of course these germs may be passed on to any town below, and there is no knowing where the disease could be stopped. The first thing is to get the effluent so as not to become offensive and a nuisance; but we ought not to stop there, but to continue until there should be no ground of contention on the quality of the effluent water.

Mr. Hanson: I will confine myself almost entirely to the chemistry of the question, and to the nature and use of black-ash waste. It was in 1875–6 when the trials took place at Leeds. The Corporation wanted to find out some method that would purify their water to the highest pitch at the least cost and with the least amount of sludge or residuum, which it had always been difficult to get rid of. There were many competitors. In 1876 there was the first meeting of the Conference on the Health of Cities and Towns at the Society of Arts, but during the time of the meeting

I was suspended at Leeds, I suppose it was that I should not have my name known as one of the competitors. The Corporation of Leeds did their very best to try to make lime do the work better and cheaper than black-ash waste. The lime, however, cost more than one-half more than lime and black-ash waste, with an effluent that was stinking and a sludge that would not set. Sludge treated with lime will not set; it quickly decomposes and stinks. It is quite the reverse with the sludge from the black-ash waste and lime. I have patented it in many forms: in a liquid form to be put down gulleys in streets, where it fixes the ammonia, and prevents it becoming nitrites and nitrates, and it does not set free the sulphuretted hydrogen. It is a preventitive of sewer gas, and when ground up into a fine powder and thrown into the catchpits in the streets, or into privies or middens, it will remedy the fæcal smell which often arises from those places, and would be of great use in stamping out typhoid fever. With precipitation by lime you get a clarified effluent which is objectionable to send into the river because it makes the water hard, and manufacturers cannot use it when it is so hard; further it kills the fish, and cattle cannot drink water so highly charged with lime; and then again there is always a smell and a secondary decomposition in rivers where lime only is used, and where sulphate of alumina or things of that sort are used it makes the water red. I do not use iron in any of my processes; I have tried it, but had to give it up because it oxidised in the water and coloured it, as it did also the stones as it went along—not a natural iron colour, but a muddy red; it would thus set up secondary decomposition by seizing hold of sulphuretted hydrogen, and in this way they got a nasty black stinking sludge all down the lines of the stream. Lime and black-ash waste are the cheapest precipitant, and give an effluent which is purer to a greater extent than what can be given by any other method unless you go to a serious cost and treat it simply with sulphate of alumina, which no country can stand. The effluent seen this day was a genuine and commercial one; genuine because black-ash waste always purifies and deodorizes, commercial because the expense was little, and no ratepayer could grumble at the cost. At Aldershot the sludge is given away, but the man to whom I gave it, sold it, after it had been dried by the atmosphere, at from 45*s.* to 65*s.* per ton. I am only too pleased that he has done so, for it shows that there is a value returned for this process.

Mr. **Angell**: Supposing that to-morrow all the country adopts black-ash waste, is there sufficient to meet the demand?

Mr. **Fowler**: I wish to ask Mr. Hanson if he thought the tanks at Leyton were sufficiently deep and large for his process, and whether they gave the sewage sufficient room.

Mr. **Godfrey**: I wish to ask how the process would answer were the waste water from paper manufactories and dyeworks; would it deal with them as with ordinary works.

Mr. **Johnson**: Could the residuum of black-ash waste be used as a manure? because local boards would look to obtain something from their outlay. In reference to lime, what made it injurious to the effluent water of an ordinary sewage work was that it rendered it alkaline.

Mr. **De C. Meade**: Will Mr. Hanson give the cost per gallon of sewage treated and the cost per head of population.

Mr. **Hanson**, in replying to the various questions which had been put to him, said that there were mountains of the black-ash waste in our country that would be sufficient to purify the sewage of England, Ireland, and Scotland for 500 or 600 years to come. The purity of the effluent from black-ash waste had been proved in all cases to be superior to any other. The tanks at Leyton were very large tanks for the number of the population. As to the purification of paper water he had had a great deal of experience; among other things they used esparto and common straw which they made into pulp, and they got a dark, discoloured water; and they used a lot of caustic soda, which went into the river. He had been connected with a paper company at Halifax who had had an injunction issued against them by some cloth manufacturers who could not use the water for the purpose of dyeing and scouring in consequence of the impurities coming from this paper-mill. He was sent for to try and get them out of their difficulty, and he got the water so purified that the millowners below, who had obtained the injunction against them, gave him a certificate that they were satisfied and that they could use the water over again. Not only was it pure, but it was colourless, whereas generally it was brown, or in cases where it was treated with sulphate of alumina it was a straw colour or deep yellow; but in this case it was pure water colour. Above, the stream was a trout stream, and, afterwards, lower down it became a trout stream again. He was engaged to go out to Moscow by some eminent machine makers. The Czar had issued an interdict to the effect that he would not allow those beautiful

Russian rivers to be polluted in the same way as our rivers are with dye and foul water. Consequently, the manufacturers had been ordered to purify their dye-water before it went into the stream, and he was going there to purify an immense quantity of dye-water. The aniline dyes of the present day were difficult things to deal with.

Mr. **Coulthurst**: I would suggest that samples of the effluent taken this day should be analysed, and the results entered on the minutes of the proceedings. I should like to add my testimony to those who have spoken so highly of the Leyton Works. The subject of the disposal of sewage is an interesting matter indeed to us as Sanitary Engineers, but unfortunately for the ratepayers it is an unprofitable one. Waterworks, markets, and things of that kind, generally showed some result, but to my mind the day has gone by for expecting sewage farms or precipitation works to return a profit; it is quite true that we hear of the residuum being sold as manure at 3*l.* or 3*l.* 10*s.* per ton, but they generally leave out the important fact that chemicals and other matters have been added which cost 4*l.* per ton. I am pleased to find that is not a policy which Mr. Dawson has adopted. He appears to have got a satisfactory effluent, and that I believe, is the only thing we have to try and obtain. What we have seen to-day is, I think, perfectly satisfactory for a town standing as Leyton does.

Mr. **Dawson**, in replying to the discussion which had arisen on his paper, said that he knew he had the confidence of every member of his Board, and what he recommended in reason was granted him, and that he thought was one of the greatest advantages a surveyor could have. As to the question respecting the night sewage, as he stated in his paper, the daily flow of sewage was 1¼ million gallons, of that a little over 1 million was treated, the other 200,000 flowing into the tanks between 10 P.M. and 4 A.M. was so diluted that the tank which received this sewage was always the sweetest in the morning. He had had samples of the sewage taken every hour of the day, and the men knew exactly how to regulate the supply of the chemicals according to the strength of the sewage. The cost was considerably under a shilling per head of the population per annum, and despite extensive works of street improvements the general district rate was only 2*s.* 8*d.* in the £ in the year. He should be glad if the Chairman of the Board would give permission to have two samples of the effluent analysed, one by the county analyst, and the other by any other chemist that the Association might choose, the results obtained to be published in the 'Proceedings' of the Association. As to the sludge question, whether it is of any value as a manure or not, the Board did not expect to get anything for it, they were too glad to have it taken away, and so long as they could get it taken away without cost as fast as they made it, they thought themselves lucky. There was, however, a little competition for it.

The **President**: The paper which has been read is valuable, and the works which we have seen interesting. They are of interest because, although to many of us the question of the purification of sewage has not yet come up, it will certainly arise with every man in the Association sooner or later. I am glad to hear Mr. Hanson's explanation and his answers to the various questions put to him. This is a capital opportunity to get his opinion, for he is shortly going to Russia, and if he does not succeed in getting a good effluent it is probable that we shall next hear of him in Siberia. As to the large supply of black-ash waste to be had in this country, I think I can offer Mr. Hanson half a million tons at the cost of taking away, and probably offer to pay a little to have it taken away. It is true that we are incidentally making use of the same process at Newcastle, but it is not so much for the purification of sewage as for the sake of getting rid of the black-ash waste. I do not know the manurial value of the sewage cake, but an experiment made on land with the raw black-ash waste was most disastrous. Before I sit down, I will ask you to pass a vote of thanks to Mr. Dawson for his very able paper, which I trust will be printed and placed in the hands of all the Members of the Association, and to thank him for the way in which he has made his explanations to the Members present; and also to the Local Board for the use of the Hall and for the courtesy which they have shown. I think that the day is not far distant when both local boards and corporations will so far recognise the benefits conferred by membership of the Association that they will insist upon their surveyors being members and attending these meetings. I am convinced that these visits of engineers to various places are a great advantage to those places as well as to themselves. They see what has been done by other people; they see the operations that have been successfully carried out, and what is, perhaps, even of more importance, they see the failures, for more may be learned from failures than from successes.

Mr. **Hanson**: The black-ash waste is in two forms, the new and the old. If taken and placed on the land when new it is disastrous, but if taken when old it is very beneficial indeed.

Mr. Fraser acknowledged the vote of thanks which had been conferred on the Local Board, and Mr. Dawson also acknowledged the vote of thanks accorded him, and repeated the wish to see the Association again at Leyton.

After the paper had been read at the Town Hall, the Members visited the Leyton Sewage Works, which were explained by Mr. Dawson. The Members then returned to the Town Hall, where the discussion upon the paper was held, and they were then entertained to luncheon by Mr. Dawson. A visit was then paid to the Abbey Mills Pumping Station.

LEYTON SEWAGE.—ANALYSES OF EFFLUENT.

5, Bond Court, Walbrook, London, E.C.
October 24th, 1884.

Sample of Sewage Effluent contained in Winchester Quart Bottle received from Wm. Dawson, Esq., Surveyor, Leyton Local Board, October 11th, 1884.

This Sewage Effluent was fairly bright and contained scarcely any suspended matter. It was distinctly alkaline.

I consider there can be no objection to running such a liquid into an ordinary flowing river.

The Free Ammonia is small in quantity, and the Albuminoid Ammonia would probably be soon destroyed by oxidation.

The alkalinity of the Effluent would be neutralised on coming into contact with a large volume of river water, giving rise to some turbidity owing to the deposition of carbonate of lime.

Analysis.	Grains per gal.
Total solids	31·50
Organic matter determined by loss on ignition of total solids	7·70
Chlorine	4·70
Free Ammonia	1·47
Albuminoid Ammonia	0·252

(Signed) Thomas Pooley, B.Sc., F.I.C., F.C.S.

Dear Sir, *21st October*, 1884.

I send you herewith result of Analysis of Sample of Effluent Water received on the 11th instant.

When first opened the Sample had a slight ammoniacal odour, which did not increase or alter in character after keeping twelve days. It contained a small quantity of suspended matter, consisting almost entirely of minute crystals of carbonate of lime and ammonia, phosphate of magnesia, and I could not detect a single animalcule or other organism of the kind invariably present in putrid sewage.

The suspended matter did not appear to increase on keeping, but the sides of the bottle became coated with minute crystals having the same composition as the suspended matter. As I was not furnished with a sample of the sewage before treatment, I am unable to say to what extent it has been purified.

From a careful consideration of the results of my examination I have to report the "Effluent" as very satisfactory, for the following reasons, viz.:—

1st. Absence of the usual offensive odour.

2nd. Absence of animalcules, fungi and other organic substances in suspension.

3rd. Non-liability to undergo putrefactive changes.

I was unable to ascertain the quantity of dissolved oxygen, and the oxygen required to oxidise organic matter in solution, as the sulphites and hyposulphites introduced in the "Black Ash Waste" seriously interfered with the accuracy of the test.

I am, dear Sir,
Yours obediently,
(Signed) W. C. YOUNG.

Result of Analysis of Sample of "Effluent" sent by W. Dawson, Esq., C.E., Leyton Local Board, dated 10th October, 1884.

Date of receipt of Sample, 11th Oct., 1884.

	Grains per gal.
Total solid residue	42
Loss on ignition	9·1
Chlorine	3·85
Ammonia as Ammoniacal Salts, &c.	1·12
Ammonia from organic matter	·16
Nitrogen as Nitrates	·428
Suspended matter	1·5
Loss on ignition of suspended matter, per cent.	23

W. C. YOUNG, F.I.C., F.C.S., &c.,
Public Analyst for the Districts of Poplar,
Whitechapel, and St. George-in-the-East.

DISTRICT MEETING AT STOCKTON-ON-TEES.

October 18th, 1884.

Held in the Town Hall, Stockton-on-Tees.

MR. G. W. LAWS, *President, in the Chair.*

THE MAYOR (Mr. Councillor SANDERSON) received and very cordially welcomed the Members, and the President having returned thanks on behalf of the Association,

The Honorary District Secretary read the minutes of the previous District meeting, which were confirmed.

Mr. P. W. Thomson was re-elected Honorary District Secretary.

EXAMINATIONS BY THE ASSOCIATION.

The PRESIDENT referred to a paper recently read at the meeting in London by Mr. Angell, in which the chief points were the question of the protection of Municipal Engineers by the Local Government Board and their examination for certificates of competency. He held that the Sanitary Institute was not the proper body to conduct these tests, that knowledge taken from books is but small compared with the real knowledge that the Municipal Surveyor should have, and contended that there was no body better constituted than this Association for testing the requirements of the Municipal Surveyor. He had found a very general opinion among the Members that the Association should be a chartered body with power to hold examinations and grant certificates. He made these remarks with the view of drawing attention to a subject which he intended should be brought forward at the next general meeting.

THE IMPROVEMENT OF THE RIVER TEES.

By JOHN FOWLER, M. Inst. C.E., Engineer to the Tees Conservancy.

The first Act for the improvement of the Tees was obtained in 1808, and in 1810 the first cut was opened, which cut off the large loop round by Mandal, and shortened the distance between Stockton and the sea about 2 miles and 5 furlongs.

The second Act was obtained in 1828, and in 1830 the second cut was opened, which cut off the loop round by Portrack and further shortened the distance to sea three quarters of a mile.

The river from Newport to Cargo Fleet was cut up by interposing sandbanks, and was continually shifting; and between the years 1830–40 a number of groynes were constructed at right angles to the stream, which to a considerable extent fixed the position of the channel, but did not effect so much improvement in depth as was expected.

In 1839 the Tees Bay Lights were first exhibited, and by the end of 1842 the river channel was lighted from the sea to Middlesbrough. In consequence of the loose and movable nature of the sandbanks these lights had to be shifted three or four times during the year.

In 1852 the first Tees Conservancy Act was obtained, which vested the conservancy of the river in a body of Commissioners, appointed by the towns of Stockton, Middlesbrough, and Yarm. At that time the navigation was in a very unsatisfactory state; as already stated the groynes between Stockton and Middlesbrough had not fulfilled expectations. The depth at low water between these places was not more than 2 feet 6 inches to 3 feet, whilst below Middlesbrough the depth was less than 2 feet, with a crooked and continually shifting channel. On the bar the depth varied from 3 feet 6 inches to 10 feet, the average depth being about 7 feet, whilst the position and consequently the direction changed more or less with every spring tide.

The Commissioners, having obtained a dredger and other plant, commenced active operations for the improvement of the navigation in 1855. Their first work was to construct low-water training walls in lieu of the cross groynes. They have constructed above 20 miles of these walls, and have fixed the position and direction of the channel from Stockton Bridge to the sea.

Whilst the effect of the groynes was to make holes at their ends with shoals above and below, the training walls gradually equalised the bottom and improved the depth wherever the character of the bottom would admit. There were, however, at different places, hard ground, locally called "scarps" on which the scour made little impression. These had to be removed by dredging. At the present time the Commissioners have four dredgers, with two rows of buckets each, at work, and lifting from 8000 to 9000 tons daily; the total quantity lifted being over 20,000,000 tons per annum.

At the eighth buoy the bottom is rock, and extended above low water half across the channel with a maximum depth of not more than 6 feet. Above 120,000 cubic yards of this rock have been blasted and removed to a maximum depth of 14 feet.

The most important work which the Commissioners have constructed is the South Gare Breakwater. This work commenced in 1863, at which time there was a depth of 3 feet 6 inches on the bar; it is nearly 2¾ miles in length. The inner end, 2 miles in length, is constructed entirely of slag from the iron furnaces; the outer end and round the head is protected with a cement concrete toe, and on the end a lighthouse is erected fitted with a 4th order Holophotal revolving light visible in clear weather 10 miles.

The effect these works have produced is to give a broad fixed channel from the sea to Stockton; whilst on the bar the depth has been increased from 3 feet 6 inches to 18 feet, to Middlesbrough from 2 feet to 13 feet, and to Stockton from 3 feet to 7 feet.

The Commissioners contemplate a further deepening of 20 feet to Middlesbrough and 12 feet to Stockton; and they have also a breakwater on the north side in progress, which they expect will have the effect not only of sheltering the lower reaches of the river, but also still further increasing the depth over the bar.

In addition to the low-water walls, about 14 miles of high-water reclamation walls have been constructed, by which about 2600 acres of land will be reclaimed.

The Commissioners obtained powers to construct these walls for the purpose of regulating and more clearly defining the high-water line and for preventing slag and other refuse from being deposited beyond that line. They receive one-half the value of the land when reclaimed, but have to bear all the cost of reclamation.

At the close of the meeting the Members proceeded to Corporation Quay, whence the steamer 'Swan' conveyed them on a trip down the river. Mr. F. Jopling, in the absence of Mr. Fowler, acted as cicerone, and explained objects of interest en route. It was stated that over a million sterling had been expended in the different works carried out by the Tees Commissioners. In carrying out the dredging operations a causeway was found in the bed of the river and numerous trunks of trees were dredged up. The Members returned to Stockton, where they dined together.

DISTRICT MEETING AT COLCHESTER.

October 25th, 1884.

Held in the Council Chamber, Town Hall, Colchester.

Mr. Lewis Angell, *Past President, in the Chair.*

Mr. E. Buckham, Borough Surveyor, Ipswich, was unanimously elected Hon. Secretary for the Eastern Counties District.

A letter was read from the President of the Association, in which Mr. Laws considered that this Association was a more fit body to examine Municipal Engineers than the Sanitary Institute, and as such it was desirable to consider the advisability of obtaining a charter of incorporation, to include power to appoint examiners and grant certificates.

The Chairman opened a discussion upon the subject, Messrs. Mawbey, Jabez Mann, A. M. Fowler, and C. Clegg taking part, and all speaking in favour of examinations, as tending to promote confidence and secure efficient men to fill the office of Municipal Surveyor.

The following resolution was then carried unanimously:—"That it be a recommendation to the Council of the Association that they take into consideration the desirability of applying for a Royal Charter of Incorporation, also the question of examinations for appointments as Borough and Municipal Surveyors."

THE MAIN DRAINAGE WORKS OF COLCHESTER.

By CHAS. CLEGG, C.E., Borough Surveyor, Colchester.

These works, now recently completed, had long been considered by the Corporation as a necessity, owing partly to the fact that many of the old sewers and drains were in an unsound state, but chiefly on account of the dangerous nuisance caused by the promiscuous discharge of the crude sewage of the town into the river Colne, and in order to comply with the provisions of the Public Health Act 1875, and of the Rivers Pollution Prevention Act of 1878.

The plans from which the work has actually been executed were carefully considered by the Corporation, and laid before the Local Government Board, and after a special inquiry obtained their sanction and approval.

The work was put up for public tender in the usual way, and that of Messrs. Bintley and Sons, of 39,000*l.*, was finally accepted by the Corporation.

The general character of the system is one of interception, the main sewer following for the most part the contour of the river, and taking up on the route such of the existing sewers as were considered to be in a sufficiently sound and otherwise satisfactory condition; but the contract also included the construction of a considerable number of entirely new sewers and drains, varying in diameter from 9 inches to 2 feet. The whole of these are laid out (as advised by Sir Robert Rawlinson, C.B., in his 'Suggestions for Sewer Construction,' published by the Local Government Board), in straight lines, with manholes or access-chambers at their junctions and intersections, which also serve the purpose of ventilators. The whole of the pipe and other drains have, with few exceptions, sufficient inclination to give a velocity to the passing sewage of over 2 feet a second, thus being, as nearly as possible, self-cleansing. In cases where it was found impossible to give sufficient inclination to the sewers to obtain this velocity, flushing-chambers of considerable capacity were constructed at intervals, the water being liberated in some cases by valve, and in others by an automatic siphon arrangement, causing a rapid discharge of the contents of the chamber into the sewer; this latter method being much better than any other at present in use.

Colchester being built on a number of small hills, the rain-water gets to the sewers in some situations with great rapidity; and it was found necessary to make some of the sewers of unusual capacity with regard to their normal work, owing to the fact of the difficulty, on account of their situation, of giving them prompt relief in times of heavy storms.

The old sewers are, wherever practicable, made use of as storm conduits, and the intercepting sewer has storm reliefs to the river, equal to four times its own capacity.

The River Colne had to be crossed under in two places, and in either case cast-iron socket-pipes were employed, the joints being made with Spence's metal. In many of the low-lying parts of the line considerable difficulty was experienced in getting a thoroughly reliable foundation, but in all cases, by increasing the area of base of, and by in some cases using timber platforms, sound work was obtained.

Along the side of the tidal river at the Hythe, where the traffic is heavy and somewhat constricted, 36-inch cast-iron pipes were used, thus enabling the work to be got through more speedily and with less interruption of the general traffic.

The last three-quarters of a mile of outfall sewer is used as a storage tank, in order to obviate the necessity of night pumping; this sewer is circular, and 6 feet 3 inches internal diameter, having a capacity of about 674,000 gallons, being about the average flow of sewage in twenty-four hours; but the quantity passing through the system in the day-time being of necessity very much in excess of that at night, this storage room is found sufficient.

In order to avoid the possibility of the gases that might generate in this sewer (which has no house or other connection) finding their way into the upper parts of the system, the tank sewer is dropped at its upper end sufficiently below the one entering it to admit of a siphon and valve arrangement, the employment of which effectually checks the passing of any gases. Where new sewers have been constructed, and where steep gradients are likely to favour the escape of sewer gas, a similar plan has been adopted.

The sewage is finally raised at the pumping-station by means of duplicate sets of three-throw ram-pumps, manufactured by Mr. A. G. Mumford, of Colchester, with valves specially designed for pumping sewage and such extraneous matters as might pass the screen chambers, the pumps being actuated by a pair of 25 horse-power automatic horizontal condensing engines, by Messrs. Davey, Paxman and Co., Colchester. The engines and pumps are so geared as to be able to work together or separately, each engine being able to work either set of pumps. The average amount pumped daily at the present time amounts to between 600,000 and 700,000 gallons, the sewers and pumping machinery being capable of dealing with double that quantity daily if necessary. After being lifted, the sewage is forced along a cast-iron delivery-main into concrete depositing tanks, in which the sludge is allowed to settle, the effluent from them passing over weir penstocks into the sewage carriers, which encircle 25 acres of land used for the purpose of, to a certain extent, purifying the sewage before its final discharge into the river, which at this point is tidal, and about seven miles from the sea. The greater part of the land over which the sewage is pumped is closely sub-drained, and is at present let on lease by the Corporation. The object being more to extract the detritus and solid matters from the sewage than to attempt to procure a chemically pure effluent, the quantity of land employed fairly answers the purpose, but a large tract of marsh and meadow land, at the same level, is available for sewage disposal purposes if deemed at any time necessary or desirable. The land has only just been got into cultivation, the lease to the present tenant dating from 25th December, 1883.

DOMESTIC WATER SUPPLY FROM SHALLOW WELLS.

By E. G. MAWBEY, Borough Surveyor and Water Engineer, King's Lynn.

In their report on the Domestic Water Supply of Great Britain, the Rivers Pollution Commissioners stated that immense numbers of the people are daily exposed to the risk of infection from typhoidal discharges, and periodically to that from cholera dejections, and that twelve millions of country population derive their water almost exclusively from shallow wells, which, as far as their experience extended, were almost always horribly polluted by sewage, and by animal matters of the most disgusting origin.

Although during the last few years many districts have been amply supplied with wholesome water, much remains to be done, and so long as it remains permissive instead of compulsory, as provided by Sect. 51 of the Public Health Act, 1875, on the part of local authorities, to provide public supplies, the necessary progress will not be made. The Public Health Water Act, 1878, for Rural Sanitary Authorities, if observed, is certainly a step in the right direction, but this is only permissive with regard to Local Board Districts.

In September 1883, the author, with the assistance of Dr. Grant, the medical officer, made a thorough investigation as to the quantity and quality of the existing water supply from shallow wells to 1188 houses with a population of 5500; in the Local Board District of Market Harborough, Great Bowden, and Little Bowden.

In carrying out this investigation, steps were taken to ascertain—1. Whether there was a supply of water on the premises. 2. Whether the quantity of that supply (if any) is sufficient for all purposes. 3. Whether the water (if any) is fit for drinking.

4. If unfit, the reason. 5. Whether, if considered unfit for drinking, it is used for culinary or other purposes. Whenever from discoloration, offensive odour, or other cause it was apparent and certain that the water was unfit for drinking, it was at once classified under that heading, but in all other cases a sample was taken. Pocket inspection books with the above headings printed in were used.

The Medical Officer submitted each sample to at least two separate processes, including Permanganate of Potash and Nessler's test, and classified them under three headings, viz: 1, average; 2, below average; 3, unfit. By these terms it was intended to convey that the word "average" meant the average quality of the purest sources of drinking water available; not that it indicated water of first-rate quality, for in only very isolated instances was water of really high standard found. Those classed as "below the average," although perhaps not actually poisonous, were considered to be most detrimental to persons using them, and, if not directly productive of actual disease, induce a low and vitiated state of health, which forms the surest groundwork for every kind of disorder, and renders the constitution less able to withstand the attack. The third class, "unfit," needs no comment.

As a result of these investigations, it was found—Firstly, that there were 210 houses without any water supply whatsoever on the premises. Secondly, that there were 143 houses in the district, which, although possessing a water supply, it was quite inadequate for domestic purposes. And thirdly, that there were 264 houses, which, although possessing a water supply, were in some instances, by reason of the very evident proofs of pollution, and in others by the result of the above tests, pronounced totally unfit for domestic purposes; in addition to these there were 312 houses to which the supply was pronounced below the average, and 442 houses to which the quality was found of average purity. There being 746 houses without a sufficient supply of wholesome water, and the remaining 442, although by the ordinary rough tests, were pronounced as of average quality, by complete analysis were found to be of doubtful purity.

With a view of corroborating the results of these tests, twelve samples, classed as of average quality, taken from various parts of the district, were submitted for complete analysis to Mr. Cassell, F.C.S., Demonstrator of Hygienic Chemistry at University College, London, who reported in the following terms:—

Condemned. Polluted with organic matter, chiefly of animal origin (such as sewage). Very hard. Excessive quantity of solid matters.	*Samples marked M.H. No. 9.
Condemned. Amount of organic matter too high. Very hard. Excessive quantity of solid matters.	Samples marked M.H. No. 125.
Passed. A very clean water so far as organic matter is concerned. Amount of solid matters too great, and the water is rather too hard.	Samples marked M.H. No. 32.
Condemned. Amount of organic matter too high. Organic matter chiefly of vegetable origin.	Samples marked L.B. No. 43.
Passed. A fairly clean water. The organic matter present is probably chiefly vegetable.	Samples marked L.B. No. 57.
Condemned. Very suspicious. Organic matter too high. Solid matters much too high.	Samples marked L.B. No. 99A.
Condemned. Amount of organic matter too high, and chiefly of vegetable origin. Contamination with some animal organic matter is also probable. Solid matters excessively high. Very hard.	Samples marked M.H. No. 164.
Suspicious. Solid matters much too high. Rather hard. The source of supply and its surroundings should be very carefully examined.	Samples marked L.B. No. 81.
Condemned. Much polluted with organic matter of animal origin (*chiefly*). Solids excessively high. Very hard.	Samples marked G.B. No. 18.
Condemned. Much polluted with organic matter of animal origin (*chiefly*). Solid matters much too high. Very hard.	Samples marked G.B. No. 44.
Condemned. Organic matter much too high, probably polluted by both animal and vegetable matter. Solid matters excessively high. Very hard.	Samples marked G.B. No. 97.
Condemned. Much polluted with vegetable matters. Presence of living animal organisms (water-fleas, &c.).	Samples marked G.B. No. 157.

In all but two of the waters—viz. L.B. 57 and G.B. 157—the amounts of solid matters present are far in excess of what is desirable. With the exception of L.B. 43, L.B. 57, L.B. 99A, and G.B. 157, they are remarkably hard waters. In each of the above cases of pollution with "animal organic matter" the latter may be sewage, and I am of opinion that such is the case.

It is extremely probable that the sources of supply of the following—viz. M.H. 9, M.H. 164, G.B. 18, G.B. 44, and G.B. 97—are in close proximity to some source of organic pollution. If these waters are drawn from wells, I think it likely that there has been percolation of organic filth through the surrounding soil into the wells, a process which may still be going on.

To facilitate comparison, the analytical results are stated in "grains per gallon," in parts per hundred thousand parts of water, and in parts per million parts of water. Where the suspended matters have been sufficient in quantity, microscopic examination has been resorted to.

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* M.H. means Market Harborough. G.B. means Great Bowden. L.B. means Little Bowden.

Report on Analysis of Twelve Samples of

Number of Sample.	M.H. 9.			M.H. 125.		
Appearance in 2-foot tube.	Fairly clear. Yellowish tinge.			Slightly turbid. Very faint brownish tinge.		
	Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.
Total Solid Matters	125·3	179·0	1790	114·8	164·0	1640
(*a*) Volatile	58·1	83·0	830	32·2	46·0	460
(*b*) Fixed	67·2	96·0	960	82·6	118·0	1180
"Free" or Saline Ammonia	·0015	·0022	·022	·00035	·0005	·005
"Albuminoid" or Organic Ammonia	·017	·024	·242	·012	·017	·17
Nitrogen as Nitrates	1·358	1·94	19·404	·03	·05	·5
Chlorine	9·1	13·0	130	14·49	20·7	207
Total Hardness	37·8	54·0	540	46·2	66·0	660
Poisonous Metals	Absent.			Absent.		
Microscopic Examination of suspended matters	——			——		

Number of Sample.	L.B. 81.			L.B. 99A.		
Appearance in 2-foot tube.	Clear. Colourless.			Somewhat turbid. Brownish colour.		
	Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.
Total Solid Matters	95·9	137·0	1370	98·0	140·0	1400
(*a*) Volatile	17·5	25·0	250	19·6	28·0	280
(*b*) Fixed	78·4	112·0	1120	78·4	112·0	1120
"Free" or Saline Ammonia	·054	·078	·78	·019	·028	·28
"Albuminoid" or Organic Ammonia	·004	·0058	·058	·007	·010	·10
Nitrogen as Nitrates		None.			None.	
Chlorine	4·96	8·8	88·0	5·46	7·8	78·0
Total Hardness	26·6	38·0	380	10·5	15·0	150
Poisonous Metals	Absent.			Absent.		
Microscopic Examination of suspended matters.	——			——		

London,
Sept. 20*th*, 1883.

DRINKING WATER FROM MARKET HARBOROUGH.

M.H. 164.			M.H. 32.			L.B. 43.			L.B. 57.		
Rather cloudy. Faint greenish tinge.			Clear. Colourless.			Fairly clear. Faintish green tinge.			Clear. Very faint greenish tinge.		
Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.
130·9	187·0	1870	70·0	100·0	1000	53·9	77·0	770	43·4	62·0	620
60·9	87·0	870	21·0	30·0	300	18·9	27·0	270	18·2	26·0	260
70·0	100·0	1000	49·0	70·0	700	35·0	50·0	500	25·2	36·0	360
·0014	·002	·02	·00035	·0005	·005	·016	·0234	·234	·00056	·0008	·008
·0122	·017	·174	·005	·007	·07	·011	·0156	·156	·008	·0114	·114
2·33	3·32	33·26	·035	·05	·5	·606	·866	8·66	·441	·63	6·3
10·57	15·1	151	5·6	8·0	80	2·31	3·3	33·0	4·2	6·0	60·0
36·4	52·0	520	27·3	39·0	390	18·9	27·0	270	15·4	22·0	220
Absent.			Absent.			Absent.			Absent.		
Some vegetable débris. Confervæ found.			—			—			—		

G.B. 18.			G.B. 44.			G.B. 97.			G.B. 157.		
Rather cloudy. Yellow colour.			Clear. Yellow colour.			Slight cloudiness. Yellowish-green tinge.			Slight cloudiness. Slight yellowish tinge.		
Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.	Grains per Gallon.	Parts per 100,000.	Parts per Million.
141·4	202·0	2020	95·2	136·0	1360	113·4	162·0	1620	39·9	57·0	570
77·0	110·0	1100	39·2	56·0	560	50·4	72·0	720	18·2	26·0	260
64·4	92·0	920	56·0	80·0	800	63·0	90·0	900	21·7	31·0	310
·002	·0028	·028	·0022	·003	·032	·00056	·0008	·008	·005	·007	·07
·033	·047	·47	·032	·046	·464	·018	·0262	·262	·021	·0304	·304
2·8	4·158	41·58	2·328	3·32	33·2	1·45	2·217	22·17	A trace.		
13·86	19·8	198·0	5·6	7·9	79·0	16·38	23·4	234·0	1·68	2·4	24·0
30·8	44·0	440	27·3	39·0	390	30·1	43·0	430	18·2	26·0	260
Absent.			Absent.			Absent.			Absent.		
—			—			—			A little vegetable matter. Water-fleas found. Vegetable débris.		

(Signed) CHARLES E. CASSELL, F.C.S.,
Demonstrator of Hygienic Chemistry at
University College, London.

It now remains to explain the cause of this extensive pollution. Having carried out a system of sewerage extending throughout every street, and (with the exception of three or four isolated cases) passing by every house in the district, and having also carried out an entirely new system of house drainage over the whole of the district, the author had ample opportunities of noting the polluted state of the subsoil from which the drinking water was derived.

This district is situate on the Blue Lias formation, and most of the drinking water is "surface water," derived from thin beds of drift gravel, and from the loamy soil overlying the Blue Lias Clay, which is met with at an average depth of about seven feet from the surface. The water is collected in shallow wells sunk a few feet into the Blue Clay for storage. In this subsoil, from which the drinking water is supplied, is laid the old system of sewers and house drainage.

Some of the "main sewers" in the streets were of rubble stone, partly built in mortar and partly built dry, with no invert excepting the earth of the subsoil. These rubble sewers were partly covered with timber and partly with stone. Other sewers had walls of brickwork, earthen inverts, and were covered as described to rubble stone sewers, and some were defectively constructed circular brick culverts. Many of the sewers were of 6-inch, 9-inch, and 12-inch common red butt-jointed land pipes. Some of the sewers of more recent date than the above, were of glazed socketed earthenware pipes, but of inferior quality, which, with a few exceptions, were not jointed; none were well jointed at the inverts. The main trunk sewer, owing to its undulating levels alternately falling in the right and wrong direction, and to its not being jointed, allowed the liquid to escape, and left a deposit of sewage mud and detritus of considerable depth. The above sewers were intercepted by large foul catchpits in various and numerous places to receive the detritus. In laying house drainage, these sewers had from time to time been rendered more defective by being broken into to make the connections.

In carrying out the new house drainage, the author, on every property, examined, by means of test holes, the then existing drains, and noted a full description of their construction, and the extent, as far as possible, of the leakage from the same, which was further examined and noted when crossing these drains in excavating for the new drainage. The old system of house drainage, now abandoned, consisted chiefly of common red butt-jointed land pipes and tiles, and small square defective brick drains, many with earthen bottoms; and the few glazed socketed earthenware pipe drains which existed were very rarely found jointed. There were also throughout the district many other sources of pollution, such as large earthen privy cesspits, some which have usually been emptied about once in seven years; a great number of undrained pig-styes, uncovered, deep, leaky dung-pits, and ashpits which when emptied were found to contain the most offensive liquid, partly caused by the rainfall and the infiltration of subsoil water. In laying new stable drainage, the earth under the old floors was found to be polluted to the most disgusting extent. There were also the farmyards, with their accumulation of liquid manure percolating the subsoil in some of the inhabited parts of the district. Many large and small leaky and horribly foul cesspools, acting as catchpits, were found in executing the private drainage.

The result of this unsanitary state of things was, that the subsoil from which the drinking water was derived had, more or less, throughout the inhabited district, been for ages receiving the excreta from human beings and animals, and other liquid refuse from domestic use, &c.; and this was clearly proved by the small quantity of sewage which reached the outfalls of the sewers. There were parts of streets, and almost whole streets, and many back yards where wells existed, where the subsoil for a depth of several feet was completely saturated and black with sewage, which was so offensive that the men could scarcely exist in the trenches without the use of disinfectants; nor were all the sources of pollution removed when the new sewerage and house drainage was carried out. Part of the old leaky system of sewerage still remains for the surface drainage, and will continue to deposit, by leakage, the animal excreta and many other impurities washed off the surface of the streets and roofs, and that which percolates from the surface of the pebble-paved and macadamised roads and streets direct into the shallow water-bearing subsoil. And even if all the sources of pollution were cut off, it would take many years to purify such a subsoil.

The majority of the best class of country residences are also supplied from wells, which, owing either to ignorance or neglect of proper sanitary precautions, are liable to considerable pollution. Only a few weeks ago the author was called in to advise as to the sanitary condition of the residence of one of the wealthiest gentleman farmers in Norfolk. For several weeks previously every one who stayed one or two days in the house had diphtheria, till at last the place was all but deserted. On inspection the author found that the whole of the drainage, including a water-closet, passed into the chalk on one side of the house, and that the drinking water was derived from a well under the lawn in the same formation on the other side of the house. A proper system of drainage has been carried out to an outfall on the surface of land at a considerable distance in the direction of the dip of the chalk, and another well sunk about 100 yards from the house in the direction of the rising of the chalk formation. Since the alterations there has been no recurrence of diphtheria.

In King's Lynn there are a great number of underground tanks, or pools as they are called, formed of brickwork, into which the water from the public mains is received through a ball-tap, and is drawn for domestic supply by a common lift pump. For these tanks it is claimed that the water being at rest, the matters in suspension settle, and consequently the water is purer than if drawn direct from the mains, also that they are convenient for storage. There are, however, serious objections to such an arrangement; in many cases the water is polluted by the infiltration of sewage matter from the surrounding leaky drains, cesspools, and privy pits, and from the overflow which in some cases is connected with the sewage drain; many of these tanks receive the surface drainage and other matters through the imperfect covering above their water line. The ball-taps are very rarely examined, and consequently a great waste of water and saturation of the subsoil takes place. There being a constant supply, there is no necessity for storage. The Corporation, in their Act obtained in the year 1880, took power to discontinue supplying water to these tanks, and the author expects shortly to obtain the consent of the Corporation to put the same into force.

The evils of local shallow well supplies are by no means confined to water pollutions. The water having to be raised by manual labour, the water-closets and drains are generally dependent upon hand flushing, which, especially among the poorer classes, it is altogether impracticable to get satisfactorily performed. There is not sufficient water passed through the drains, and consequently the solid sewage matter is allowed to remain and decompose in the house drains, until in consequence of partial or complete stoppage, the occupiers are compelled to flush, or until it is carried off by heavy rainfall. However perfect may be the system of sewerage and house drainage, the discharge of foul decomposed instead of fresh sewage causes offensive emanations from the private drain, ventilating traps, and from the sewer ventilators; and it is doubtless in districts where local authorities have failed to provide an abundant public water supply, and where sewer flushing has been neglected, that most of the complaints against street surface sewer ventilators have arisen.

To many houses no supply whatever is available on the premises, and frequently the water is so horribly polluted as to be too offensive to use for any purpose.

That such a state of things is conducive to uncleanly and unhealthy habits, and very much favours the development of disease, cannot be denied.

There need be no hesitation in stating that it is absolutely impossible to obtain a safe supply of sufficiently wholesome water from local shallow wells in a thickly inhabited district, and that such a supply is in various ways most dangerous to health.

In this district, before the above works were carried out, there was no public water supply, and between 1848 and 1881 the death rate increased from 20·55 to 23·99, an increase of 3·44 per thousand. Now considering the district, this is a high death rate, because in every other respect the locality is very healthy indeed, and had there been a proper water supply, the rate would have decreased instead of increasing. The increase only goes to show how the polluted supplies have militated against the public health.

DISCUSSION.

Mr. E. **Buckham**: If there is one subject that requires attention more than another in connection with public sewerage it is that of ventilation. I have no doubt you all know that although open ventilators level with the surface of the street are considered to be the recognised principle of ventilating sewers, still there are great complaints of the nuisances arising therefrom. This is particularly the case in old towns such as Colchester and Ipswich, which I have the honour to represent, and other places, where there has been in use a system of old, irregular, and badly-constructed sewers. The sewers of Ipswich are ventilated by open ventilators level with the surface of the streets, and as the streets are very narrow the nuisance that has arisen from these ventilators in some isolated cases has been rather objectionable. Of course it is impossible to have any sewer openings without a certain amount of smell, but I have always thought that vertical pipes would be a very admirable addition to the open ventilators, though they ought not to take the place of them. I am inclined to think that the system of ventilation should be partly by street openings and partly by vertical pipes, and I consider that the maximum area in the aggregate of the vertical pipes should exceed the maximum area of the open street ventilators. I believe if this were systematically carried out we should find as a rule that there would be a down draught in the open street ventilators and an up current in the vertical pipes. I have made twenty experiments in Ipswich with vertical pipes with most satisfactory results. I commenced to make these experiments with a certain amount of diffidence because I had heard that vertical pipes were of very little use—that they had been tried in various places and had turned out comparatively a failure. Speaking from my own experience I can say without hesitation that the vertical pipes I have experimented with have had the desired effect, and I feel sure if the number of pipes were extended to a large extent the smells from the open ventilators would be very materially reduced, because in many cases we should find that instead of being outlets for sewer gas, they would prove to be inlets for fresh air. The vertical pipes should always be fixed as near as possible to the manhole opening. Another cause of bad smells in old towns has hitherto been the defective system of house drainage. A great many houses were drained into cesspools with overflows into the sewers. These cesspools act really as gasometers, producing very objectionable gases. The deposit of this putrescible matter sends off a gas which eventually gets into the sewer. In carrying out a complete system of sewers you have a lot of this objectionable sewage flowing from these dead wells and passing into the general system of new drainage, and the noxious gases eventually find their way into the street. I hope that by a systematic arrangement of upright pipe ventilators, the abolition of dead wells on private property and the reconstruction of the house drainage of our borough we shall be able to get rid of what has been not a little trouble to us. Of course in addition to fixing up vertical pipes in safe and suitable positions, I have always used chimney shafts in connection with factories and other places where I have had an opportunity of doing so. I find on examining the outlets of these vertical shafts there is always a strong current of sewer gas passing up. I cannot say that it is a constant current. Of course it is very materially influenced by the atmosphere. Atmospheric influences will always more or less affect the current of sewer gas. Then I noticed that where the current was passing up the vertical pipes, which in my case have always been fixed against the manholes, there was little or no smell from the manhole opening. I think that is evidence that the vertical pipes are doing good service, in fact I am so far satisfied with them, and I believe the Sewerage Committee are so far satisfied with them, that we intend to extend the number very materially. We had a little difficulty in finding suitable positions for the ventilating shafts at first, but the owners of property generally allowed us to put up these pipes against their premises on the authority giving them an undertaking to remove them at any time if called upon. We have found a great many places, and I hope we shall find a great many more—in fact I hope these pipes will soon be counted by hundreds. We try to put the pipes in such positions as will not interfere with the architectural appearance of the house, always preferring to place them at the gable ends. I always carry the pipe upwards from the manhole as rapidly as possible, avoiding as far as I can anything like a right angle.

Mr. SANTO CRIMP: In my district (Wimbledon) complaints are frequently received as to foul smells from the sewers. On investigating the cause, it is generally found that the manholes complained of are situated quite close to the kerb. In all such cases permission is asked to erect ventilating pipes at the side of the most convenient house, and when granted, and pipes are erected, the nuisance is abolished. Where permission cannot be obtained, a ventilator is erected in the centre of the roadway, thus removing the opening for the escaping gas as far as possible from the footways, and in such cases complaints have ceased. In other cases manholes have to be closed entirely, but new openings are then made in lieu of those closed, in such positions as not to give offence.

Mr. JABEZ MANN: I succeeded to the surveyorship at Sevenoaks after a system of sewerage had been carried out on the separate system; it has not, however, been carried out in its entirety. Immediately upon my succession to office and for some time after, frequent and constant complaints were made of stenches from the surface street ventilators to the sewers. I suggested the erection of tall ventilating shafts of not less than 30 feet in height in suitable positions wherever practicable, and more frequent flushing of the sewers. Most of the sewers have sharp gradients, and the intercepting sewers run into the Darenth Valley sewerage system, and that communicates with the West Kent main sewerage. In consequence of Sevenoaks being situate on a hill, and the sharp gradients of the principal sewers, there is little doubt but that the gases from the valley more or less ascend and aggravate the cause of complaint. I found two of Field's automatic flushing tanks had been constructed in good positions; they, however, were not working in consequence of faults; these were remedied, and they now work efficiently; also a large tank, capable of holding 10,000 gallons, has been converted into a flushing tank with penstock arrangements, and utilised for flushing the sewers of the two principal streets, being about three-quarters of a mile and one mile in length respectively. The tank is supplied by meter, at a charge of one shilling per 1000 gallons from the water company's main. I have erected from twenty-five to thirty ventilating shafts, fixed to buildings and trees, principally of eight inches in diameter, and not any of less than six inches in diameter; I have also made a connection from the sewer with the gas company's chimney shaft, which is about sixty feet high. I have also put in a 12-inch siphon on one of the main sewers with a ventilating shaft on the Darenth Valley side of same to prevent the ascension of sewer gas from the valley, but I have not closed a surface ventilator in any case. The result of these works has been satisfactory so far as the immediate portions of the sewerage system are in proximity to the respective works. One of the greatest difficulties in this question of stenches from surface ventilators that I have experienced is owing to the hot liquor and waste periodically discharged from a large brewery, which is discharged into the sewer of one of the principal streets of a mile long before mentioned, and while this is being discharged the ventilators on this line of sewer give off most offensive odours. Sevenoaks being a fashionable summer resort, this considerably militates against its interests in prejudicing visitors. In perusing the Rivers Pollution Act 1876 I found a clause in section 7 which appears to me to bear upon the question, and likely to assist local authorities in this matter, and I should be glad to hear the opinion of those present upon this subject and the section I have referred to; I have not had a legal opinion, but the clerk to my Board (who is not a legal practitioner) raises a doubt as to the Act applying to a district which does not convey its effluent immediately into a river. The section, however, states, "Every sanitary or local authority, &c." The clause I refer to reads as follows:

Sect. 7. "Every sanitary or other local authority having sewers under control shall give facilities for enabling manufacturers within their district to carry the liquids proceeding from their factories or manufacturing processes into such sewers:

"Provided that this section shall not extend to compel any sanitary or other local authority to admit into their sewers any liquid which would prejudicially affect such sewers or the disposal by sale, application to land, or otherwise, of the sewage-matter conveyed along such sewers, or which would from its temperature or otherwise be injurious in a sanitary point of view."

I think the part of the section "which would from its temperature or otherwise be injurious in a sanitary point of view" infers that liquor of a high temperature is not intended to go into the sewer unless it has been previously cooled. Mr. Walker, engineer to the Croydon Corporation informs me that he had a similar case to mine in that district, and the brewer in that case agreed to construct a cooling pond; but hitherto the gentleman I have referred to refuses to incur the necessary expense; if, however, the section above quoted is applicable, then such cases can be effectually dealt with.

Mr. A. M. **Fowler**: The discussion has only taken one phase, i. e. the ventilation of sewers so far as it affects the outer street. Nothing has been said as to how far it affects the interior of dwelling-houses. It is very important in placing these pipes vertically near to a house, that the sides next the building should be hermetically sealed, and that they should be taken well above the eaves, in order that no sewage gas can get under the roof or into the back windows of the house. I go so far as to say that so far as the house is concerned there must be no connection with the sewer whatever. People say, "It cannot be done; we cannot possibly do without a connection to the sewer;" but I say it can be done, and I am prepared to show how it can be done. If, then, there is no connection between the house and the sewer, there is not much fear of sewage gas getting into the house. When in Leeds, making experiments on the ventilation of sewers, I found the simplest plan was to connect the sewers with mill chimneys wherever I could, although it had but a limited effect upon the sewer, because the sewer *is not* a sealed channel, and the chimney simply drew the air from the first opening and had little effect upon the sewer generally. I put into the centre of the street as many openings as I could.

Mr. **Mawbey**: You may dispense with the separate system in a seaport town, or where you have a tidal river into which the sewage could be discharged, but it is a very different thing in a Midland town where, under the Rivers Pollution Act, you have to purify the sewage on land or by other means. In such a place it is next to impossible to have the combined system unless five times as much land is purchased as is required under the separate system. Therefore I think that the separate system is absolutely necessary in cases where you have to purify the sewage either by chemicals or by land filtration. I find no difficulty in getting the sewers flushed by the rainfall, the only difficulty I have is to keep the rainfall out of the sewers. Under the Public Health Act we have no power to carry out the separate system in house drainage, therefore we are obliged to admit a great deal of rain-water from back roofs and yards. There is one other matter I should like to allude to: we do not yet seem to know how to construct "pipe" sewers in a very wet soil to make them absolutely water-tight by jointing only. I have seen many sewerage schemes carried out, but I have not yet seen one that was perfectly water-tight; a great deal of water gets in, however carefully constructed the sewers are, unless you go to the expense of surrounding them in concrete or of using iron pipes. At the Leicester meeting, Mr. Gordon expressed the opinion that regulations ought to be in force preventing the discharge of hot liquors into sewers. The hot liquor in a sewer doubtless expands the air and drives out the sewer gas with tremendous velocity. The great difficulty to contend with in ventilating old sewers and drains in old towns is often not so much in the sewers themselves as the decomposed matters in the private drains. Most of the private drains in these old towns are very badly constructed, and the sewage matter remains on the premises until it is completely decomposed, and it is then carried into the sewers in such a state that it becomes almost impossible for any system of ventilation to cope with it. I believe that this decomposed sewage matter from defective private drains is one of the most fruitful sources of the complaint against the street surface ventilators. With regard to the flushing of sewers, I think it very desirable indeed to put down a sufficient number of automatic flushing tanks.

One of the best arrangements I have adopted is Adams' flushing siphon, which can be so readily built into the wall of the tank, and the water supplied by means of a small service pipe from the water main. Of course there is great risk in doing this if proper precautions are not taken. When I first went to Lynn, I found 3-inch, 4-inch, and 6-inch water pipes laid direct from the water mains into the sewers for flushing purposes—in fact all the water mains were in direct communication with the sewers, only being separated by the sluice valve, which when out of order or not securely turned off and the mains empty for repairs, &c., or when muck water was drawn off, gave rise to a tremendous in-current of foul air to the water mains. In the last flushing tank I constructed, I put a ventilating manhole cover in the top of the tank, and I laid the service-water pipe into the tank, terminating with a tub tap, right underneath the manhole ventilating cover. I also fixed a ventilator to the manhole at the discharging end of the tank; then, of course, Adams' siphon was a trap, so that there was not the slightest danger of sewer gas getting into the water mains.

Mr. **Clegg**: Fortunately we have no chemical works in the town, so that we are not troubled with chemical effluents of any kind. With regard to the hot liquor from breweries, it goes into the sewer *ad lib.*, and no attempt is made at present to prevent it. I always fancy these are very difficult things to deal with, because unless you treat them very carefully you will find that to a certain extent you are checking local trade and enterprise. We have made no attempt to prevent anything whatever going into the sewers except sand and those things likely to choke them. I am glad the subject of the ventilation of sewers has arisen, because it is a subject that is engaging a good deal of attention, not only in Colchester, but in nearly every town in the kingdom. When I made the drawings for the new sewers in Colchester I prepared a plan showing the system of ventilation I should like to have seen adopted; that is to say, wherever possible to carry a pipe from the manhole to a shaft at the gable end of the house, and so ventilate the sewer in the manner Mr. Buckham has described, the only difference being that I should have endeavoured to get these shafts immediately at the back of one of the main flues of the house. Then the air in the shaft would get heated and cause a partial vacuum; and possibly we should get a current of gas always passing up the pipe. The only doubt I have about vertical pipes being useful is this: I do not altogether see why there should be sufficient power in the shaft to draw any accumulation of gas from the sewer without the help of the open manholes as well. If you close the manholes and trust to the pipes alone the inhabitants of the town will certainly say, "What a glorious success these pipes are; we have no smells now," for the very reason that the manholes are closed up. On the other hand, if you use these pipes with the manholes it appears to me the natural duty of the pipe is simply to draw the air from the manhole opening; if there is a partial vacuum in the pipe it will feed itself from the nearest source. It appears to me a very difficult question, and one of which I cannot at present see the solution. There is no doubt that with open manholes and pipes you will get a better system than with open manholes alone; but I believe the time is not far distant when we shall have to close all these manholes up—public feeling is so strong against them. I could quote you cases in this town in which even before a pint of sewage was put into the sewer people have complained of the fearful miasmas arising from these manhole openings, and one medical man who complained to me would not credit it when I told him that not an ounce of sewage matter had been put into the sewer. There is no doubt that the prejudice against these manhole openings is very great, and I cannot say that it is altogether unreasonable. I have had Adams' siphon fixed in the manner Mr. Mawbey describes. There is no difficulty in disconnecting the water main from the sewer, if you construct a separate chamber and lay the pipe into it underneath a ventilator and then let the water flow from this chamber over a weir into the flushing chamber; then you break the connection between the sewer and the water main altogether. Sometimes the siphon is continuous in its action—it does not untrap itself, so you do not get the full benefit of the flushing head. I am trying to avoid that by a contrivance of my own by which as soon as the tank is full the siphon will untrap, and the whole of the water will be discharged into the sewer at the velocity due to the maximum head.

Mr. ANGELL remarked that he thought very unnecessary fears and complaints were made as to the occasional smell of sewage from street ventilators. People sometimes complained of street ventilators while their own houses were much more dangerous from want of cleanliness and ventilation. It had already been said that it was impossible to have sewage without smell, smell must escape somewhere, and the sooner the better, to escape into the middle of the street by surface ventilators was better than to allow it to force its way into houses. Small shafts upon houses, &c., did not give sufficient freedom of outlet, there was great friction due to length, and the danger of concentration into upper rooms and down chimneys. Excepting locally, large shafts with furnaces or gas jets were not found to have much effect, the ramifications of sewage systems with so many small lateral drains did not permit of the action of shafts as in the up and down casts of mines. We have it on the authority of the late Mr. Morant, Borough Engineer of Leeds, a gentleman of great experience, that the free opening of several thousands of street ventilators in that borough had a most satisfactory effect upon the condition of the sewers. Charcoal filters and like contrivances really formed blocks, and were soon inefficient by reason of dampness and other causes. With regard to the separate system of drainage, it was never thought of in reference to town drainage until necessity arose for treating sewage at the outfall, so as to prevent rivers pollution, when volume became a matter of importance, and means should therefore be taken to separate the varying rainfall from the more constant flow of sewage. With regard to shallow wells the evils were only too obvious, as described by Mr. Mawbey.

In conclusion, Mr. Angell proposed a cordial vote of thanks to Mr. Clegg for the great trouble he had taken in connection with that meeting, and in explaining the Colchester Sewage Works, which was carried unanimously. A vote of thanks was also passed to the Mayor for his courtesy in granting the use of the Town Hall for the Meeting.

During the day the Members visited the Pumping Station and Outfall Works.

DISTRICT MEETING AT TORQUAY.

October 25th, 1884.

SOME ACCOUNT OF THE PUBLIC WORKS IN TORQUAY.

By JOSEPH HALL, Assoc. M.I.C.E., Surveyor to the Local Board, Torquay.

Although the main drainage of Torquay is probably familiar to those Members of the Association who are also members of the Institution of Civil Engineers, through the very able paper submitted to that Institution by Mr. Chatterton in 1880, and published in vol. lxi. of the 'Minutes of the Proceedings,' it may be of interest if a short description of the work, together with the subsequent extensions, be now given.

Until the year 1874 the whole of the sewage was, as is still too common in seaside towns, discharged into the bay near the town, one pipe discharging near the Cockington boundary and one near Cary Green; but although this system effectually disposed of the sewage, it rendered the waters of the bay extremely offensive—the solid particles floating upon the surface for a considerable time—and thus caused the water to be unfit for bathing, boating, &c., and if cast ashore gave rise to objectionable if not dangerous odours.

To remedy this very unsatisfactory condition, many schemes were suggested, irrigation on the low-lying meadows near Paignton, chemical precipitation, a main sewer discharging into the sea at the Natural Arch, at Daddy Hole Plain, at Kilmorie and at Hope's Nose. Probably the grandest scheme was to carry the sewer under a coast drive from the Bath Saloon to an outfall at Meadfoot Beach.

After long and careful experiments, it was found that at all points other than Hope's Nose, the tidal currents at some time in each day set inwards, but at Hope's Nose they are invariably outward and never inward.

Now that the sewer is made, in calm weather it is easy to follow the sewage as it flows in a direct line into the tideway of the English Channel and is lost. So far as can be seen, no part of it returns to the coast, and the rocks in the immediate vicinity of the outfall exhibit no trace of sewage matter.

The total length of new sewer constructed under the direction of Sir Joseph Bazalgette, was 3 miles and 397 yards of high-level, and 1728 yards of low-level sewer.

The contract was taken by Messrs. Bell and Sons for the sum of 38,466*l.*, but after meeting with many difficulties, which had not been foreseen, at the end of ten months the contractors failed, after having executed work to the value of 8000*l.*, and fresh tenders were advertised for, but the serious difficulties which had beset Messrs. Bell and Sons appeared to have alarmed the contractors who tendered. The lowest tender was 75,000*l.*, and this did not include the pumps and pumping-station, the construction of a new road, cost of compensation, easements, engineering and law charges, which would have brought up the cost to 103,327*l.*, and as this was considerably in excess of the engineer's estimate, the Board declined to accept any tender, but acted upon the advice of Sir Joseph Bazalgette, and carried out the works without the intervention of a contractor.

The wisdom of this course was fully manifested in the result, which is shown in the following figures:—

	£
Total of the lowest tender and supplementary works and law charges	**103,327**
Total cost of works, as per accounts	**66,145**
Saving by not accepting tender	**£37,182**

The portions in tunnel are principally in the hard Devonian limestone, and the work is specially notable for the extent to which machine drilling and dynamite were used in sewer work.

The greater portion of the sewer is 7 feet in diameter, and is formed in some parts of three and four rings of brickwork, in other parts of concrete, and in those parts where the rock is sound the sewer is simply cut out and the invert lined with cement.

An important portion of the work was building the sea-wall at Meadfoot to form and protect the road under which the sewer is laid. It is 17 feet 6 inches in height and about 5 feet 6 inches in thickness. The construction is of the most irregular coursed work, and the parapet is formed of stones built into the wall vertically, some exceeding 15 feet in length, but in spite of its magnificent appearance it is a striking warning to young engineers to be extremely careful in regard to foundations. In this case the rock (geologically grauwacke, locally shillet) was so hard that blasting had to be resorted to for putting in the foundations, and yet at the present time men are at work underpinning, in some parts to the extent of 4 feet in depth, the sea having removed the rock from the face of the wall below the footings, and so altered the character of that upon which the wall rests that what appeared, when the wall was built seven years ago, to be solid rock, is now a clay shale and utterly unfit to support any weight or to resist the action of the sea for even a few hours.

After the completion of the foregoing works, it was found that some portions of Union Street and Fleet Street were still liable to be flooded. The Board therefore instructed their surveyor (Mr. Little), to prepare a scheme for carrying off the storm water. He recommended that a 5-feet barrel sewer should be constructed in Fleet Street, and one varying from 4 feet 3 inches to 4 feet 9 inches in Union Street, that an existing stone culvert should be lined with brickwork and concrete, and that large catch-pits should be formed to intercept the sand and mud and thus prevent its entry into the sewer. A large reservoir was also formed in the Upton Valley for the purpose of impounding the storm water and allowing it to escape gradually.

In July 1881 a contract was entered into with Mr. Auguste Krauss, of Bristol, for a portion of the 4 foot 3 inch barrel sewer, and for lining the stone culvert, upon a schedule of prices. On the 1st September, 1881, the author was appointed surveyor to the Board and took charge of the work, which was completed April 1882, at a cost of 1257*l*. 11*s*. 6*d*.

On the 12th May, 1882, the contract for the second portion was taken by Mr. James Hawkins, of Dawlish, for the sum of 2069*l*. 12*s*., and was completed by him on 12th November, 1882.

Street Improvements.

The growth of the town from a fishing-village to its present extent is well shown by the census returns:—

1801	838 inhabitants.	1851	11,475 inhabitants.
1811	1,350 „	1861	16,419 „
1821	1,925 „	1871	21,657 „
1831	3,582 „	1881	24,760 „
1841	5,982 „		

The increase having been entirely unforeseen, several of the principal streets were much too narrow for the traffic, and the natural configuration of the ground rendered it impossible to lay out new streets.

The worst cases have been materially improved, including the Strand, Fleet Street, Union Street, and Torwood Street; the nett cost being about 40,000*l.*, requiring for interest and redemption a rate of 4½*d.* in the £.

Roads and Streets.

There are 34 miles of roads, including 7 miles of main roads, and the annual cost of maintenance is about 2400*l.*, but this includes the repairs to a sea-wall and road which are damaged by every gale.

The material used is a compact limestone, which is well fitted for forming good smooth roads, when not required to carry excessive traffic. The cost, broken by machine ready for use, is 1*s.* 3*d.* per cubic yard, or about 1*s.* 2*d.* per ton, and the quantity used is about 7000 tons.

The cost of coating was recently found to be 5·35*d.* per square yard, and was divided as follows:—

	d.	
Metalling	1·6	per square yard.
Gravel	·74	„ „
Manual labour	·87	„ „
Team	1·84	„ „
Rolling (steam)	·3	„ „
	5·35	

The cost of horse-rolling was found to be about ·56*d.* per square yard.

Paths.

The large number of winter visitors renders it imperative that the footways should be maintained with such materials as will be clean in wet weather. York, Caithness, Purbeck, and limestone flagging, pebble pitching, tar paving, and gravel of various kinds, have been tried, and for certain purposes each is useful.

If first cost is not considered, but only the best pavement to resist excessive traffic, probably the best is York flags, from the Halifax district. Caithness wears fairly well, and has the advantage of being fully squared through, the flags are large and of uniform thickness, and consequently can be laid expeditiously and cheaply.

Purbeck and limestone are usually in small stones, but as they are readily dressed on the face, they have been much used for turning corners at a sharp gradient. Limestone has the disadvantage of becoming slippery after it has been in use a short time. The use of Purbeck and limestone is now discontinued.

Pebble pitching was much used in the earlier periods, and some portions remain, but it is not now laid. It appears to have worn very well and the appearance is very good, but the material is difficult to obtain.

Flint gravel from the deposits near Aller, wears well, but is liable to a growth of vegetation.

The gravel now used is the fine screenings from the stone-crusher; it is durable, does not vegetate, wears smooth, and is cheap in first cost, but for some time after being laid with it, the paths are rough and unpleasant unless rolled excessively. It is found that the best results can be obtained by coating the path somewhat thickly in wet weather, and after a few weeks use, brush off the loose stones from the surface.

The most satisfactory material now in use is tar paving, a kind of artificial asphalte prepared and laid cold, without the objectionable fumes of the hot process. The mixture is composed of:—

18 cubic feet clean hard ashes.
30 „ „ limestone gravel.
13½ „ „ Lyme Regis lias lime.
30 gallons gas tar.
50 to 60 gallons water.

The ashes must be absolutely free from charcoal or other vegetable matter, and must pass ½-inch mesh. Probably the ashes from gasworks or an engine are the best.

The gravel must be perfectly clean and free from soil or clay, and should pass ½-inch or ⅝-inch mesh, as the smallest amount of impurity damages the quality of the path and renders it less durable.

The lime should be a high-class lias, as pure as possible, slacked at least twenty-four hours before mixing.

Tar is the constituent most liable to variation, some being entirely unsuitable, but it is usually assumed that the tar must be from works using a considerable portion of cannel coal.

The plant required for preparing the materials includes a vertical pug-mill worked by horse- or steam-power, the small hand-machines do not mix the materials thoroughly. A large shed should be provided, with a smooth impermeable floor and of sufficient capacity to hold three to four days' supply. There should be screens of ½-inch and ⅝-inch mesh; the revolving screens are found to give the most satisfactory results.

The lime, gravel, and ashes are mixed dry, as in mixing concrete; the tar is then added as the materials are being turned over; the water is then added, and the whole is mixed as mortar with shovels until the tar and water are absorbed. The mixture is now passed twice through the pug-mill. During this operation most of the water is expelled, and provision must be made for draining it away. As the mass issues from the mill it has the consistency of stiff mortar, is of a dull black colour, and is ready for laying. The bed for laying is prepared in the same manner as for cement concrete, and is well watered from the rose-head of a garden watering-can immediately before laying down the tar concrete. The surface is finished from ½ inch to ¾ inch above the kerb to allow for compression by rolling and the traffic before the concrete becomes thoroughly hard.

After being trowelled to a smooth surface it is left for the night, next morning it is rolled with a smooth iron roller weighing about 2½ cwts., and each day for three or four days, depending on the state of the weather; hot, dry weather hastening the setting, and dull, wet weather retarding it. At the end of about a week the path will be fit for traffic, but will not be perfectly hard until after a further period of from ten days to a fortnight.

The cost, including carting, watching, &c., averages about 1*s.* 6*d.*

per superficial yard, and lasts without repairs for about ten years. A specimen which had been laid thirteen years was exhibited. The same material is used largely for forming channels by the roadsides, and is very useful in preventing scour and the growth of weeds.

Pleasure Grounds.

The total area devoted to public pleasure grounds is 59 acres, exclusive of several large gardens owned by a number of houses in common, such as Wellswood Park, Torre Park, Belgrave Park, &c. The annual cost is 560*l.*, or about 1*d.* in the £.

One of the most striking features in Torquay Gardens is the luxuriant growth of sub-tropical plants in the open air, especially those which require an equable, but not necessarily high temperature, such as Camellias, Yuccas (several are now in bloom), Dracænas, Agaves (one of which flowered last year), myrtles, vines, figs, &c., although there is frequently an insufficiency of heat to ripen the fruit of the latter.

Waterworks.

The supply is taken from an impounding reservoir at Tottiford, on the borders of Dartmoor, and which has a capacity of 100,000,000 gallons. Works are now in progress for constructing an additional reservoir to contain 200,000,000 gallons.

The water is conveyed to Torquay, a distance of 14½ miles, through a cast-iron pipe, which is 10 inches in diameter from Tottiford to Newton, a distance of about 8 miles, and 9 inches in diameter from Newton to Torquay, but since the main was first laid, the growth of the town has been such as to necessitate the duplication of a portion of the length, and it is proposed ultimately to duplicate the whole.

The system of laying a pipe sufficient to meet present needs and preparing to lay a duplicate in sections to increase the supply as required, is one worthy of serious consideration from a financial point of view, and cannot be better set forth than in the words of a report on the subject, presented to the Water Committee of the Torquay Local Board of Health, by Mr. H. M. Brunel, M.I.C.E., in which he says:—

"The plan of providing by instalments, instead of laying the additional main throughout at once, will save 8400*l.* in the cost of each complete pipe, taking 3½ per cent. as the rate of interest on the money.

"It has this additional advantage, that should a period of stagnation occur, and the rate of increase in population fall off, the instalments can be postponed, and the town would not be saddled with an unremunerative outlay."

Shortly after the first main was laid in 1865 it was found that the rate of supply was much reduced, and after one year's work the delivery was found to be less than 50 per cent. of the original supply.

Upon examination it was found that the unusual purity and softness of the water (·61 Clark's scale) had produced an extraordinary amount of oxidation in the whole interior of the pipe, which was accumulated in nodules in some parts ¼ inch in height; the consequence was an obstruction in the flow of the water, caused partially by the reduced area, but principally by the rough surface of the pipes.

During the consideration of the question of laying a larger main, the late Mr. Appold suggested the employment of a mechanical scraper, to be propelled by the pressure of the water flowing through the main, and fitted with knives, so as to scrape the incrustation from the surface as it passed along. This proposal was warmly supported by the late Mr. William Froude, F.R.S., who took great interest in the matter, and suggested many of the improvements which led to the ultimate success of the system.

The scraper now in use may be described as a series of wedge-shaped cutters, each mounted separately, and in such a way that it is free to move, either backward or inward, independently of the others, but held in place by strong springs, which only come into action when any unusual obstruction is met with, such as a bad or open joint, in which case the particular cutter which is engaged yields backward and inward, and thus clears the obstruction. The pressure of the water is communicated to the scraper through a double piston, of such a length that one disc is always past any opening before the other reaches it.

The principal cost of adopting this system is the insertion of door pipes and the alteration of small radius bends to large ones.

The following table gives the delivery in gallons per minute, after scraping, for the first seven years after the system was adopted. The delivery before the first scraping was 317 gallons per minute:—

In 1866	.. ..	454 gallons per minute.
„ 1867	.. ..	564 „ „
„ 1868	.. ..	624 „ „
„ 1869	.. ..	659 „ „
„ 1870	.. ..	668 „ „
„ 1871	.. ..	684 „ „
„ 1872	.. ..	681 „ „

The scraping is now done regularly by the men ordinarily employed for repairs, at a very small cost. No difficulty is found in following the scraper, the noise made by its passage being a sufficient guide to its position.

During the building of the dam to form the new reservoir, a somewhat unusual difficulty was encountered. The general formation is granite, and the design was to excavate for a short distance into this rock and form a concrete wall, and upon this to build a puddle wall, but on sinking into the granite it was found to be fractured in every direction and full of water, the excavation was then carried to a considerable depth and filled with concrete, but this did not prevent the water from passing through. The engineer for the works, Mr. H. M. Brunel, M.I.C.E., after a consultation with Mr. J. F. Bateman, M.I.C.E., decided to adopt an entirely novel plan, which it is believed has not been employed for a similar purpose before, and in this instance it has proved a complete success. The proposal was to excavate to the bottom of the old concrete and put in a floor of concrete (two parts stone to one part Portland cement), and then carry up a shield of wrought iron, the sheets rivetted together; the shield is fixed as close as possible to one side and the space filled with concrete similar to the floor; the larger space is filled with concrete in the proportion of ten parts stone to one part cement. The top edge of the plate is embedded in a layer of cement concrete in the proportion of two parts stone to one part Portland cement, and this is carried across the whole width of both new and old concrete, and upon it the puddle-wall is built with an embankment in the usual manner.

Scavenging.

Under this head is included the sweeping of all roads and streets, as well as the removal of household refuse, and to this work special attention is given. The principal roads and streets are swept daily, and every road and street in the district is swept at least once a week. No refuse is allowed to be deposited within the district, but is removed as soon as collected, and consequently the costs are somewhat higher than they otherwise would be.

The average expenditure is about 2000*l.* per annum, which is equal to 4*d.* in the £ upon the present rateable value.

Public Lights.

The total number of public lamps is 559. The cost of gas last year was 1141*l.* 4*s.* 1*d.*, and the total cost 1817*l.* 6*s.*, which is equal to 3*l.* 5*s.* per lamp, or 3⅝*d.* in the £ on the rateable value.

Within the last three years Borradaile's Governors have been applied to all the street lamps, the consumption being 6 feet per hour in the main thoroughfares, and 5 feet per hour in all others, The economy arising from their adoption is seen in the following comparison, more especially when it is remembered that the 1884 figures include the consumption of gas in several of Bray's and Sugg's lanterns of large power:—

	Consumption.	Cost.	No. of Lamps.	Cost per Lamp for Gas.
		£ *s.* *d.*		£ *s.* *d.*
1880 ..	6,630,593	1276 4 2	499	2 11 2
1884 ..	6,086,470	1141 4 1	559	2 0 10

Sanatorium.

During the year 1883 the new sanatorium, erected from the designs of Ernest Turner, Esq., was finished and occupied, and has since proved to be of great value.

In a town like Torquay, with a large floating population, the possibility of an infectious disorder being introduced is very great, and it is therefore necessary that means should be at hand to arrest its progress, by isolating the first case and providing for visitors who may have the misfortune to be from home when the disease declares itself all the best appliances that science can devise to assist towards a speedy recovery.

During the year a striking illustration of the value of isolation was given. A servant in one of the large houses in an adjoining district was corresponding with a relative who was recovering from small-pox; she took the infection, and was removed to the sanatorium as soon as the disease declared itself. Although a very severe case she ultimately recovered, and no other case has since occurred in the district.

The cost of the building and furniture was 3500*l*., and the annual charge to the ratepayers will probably be about 350*l*., including interest and redemption.

Sea Defences

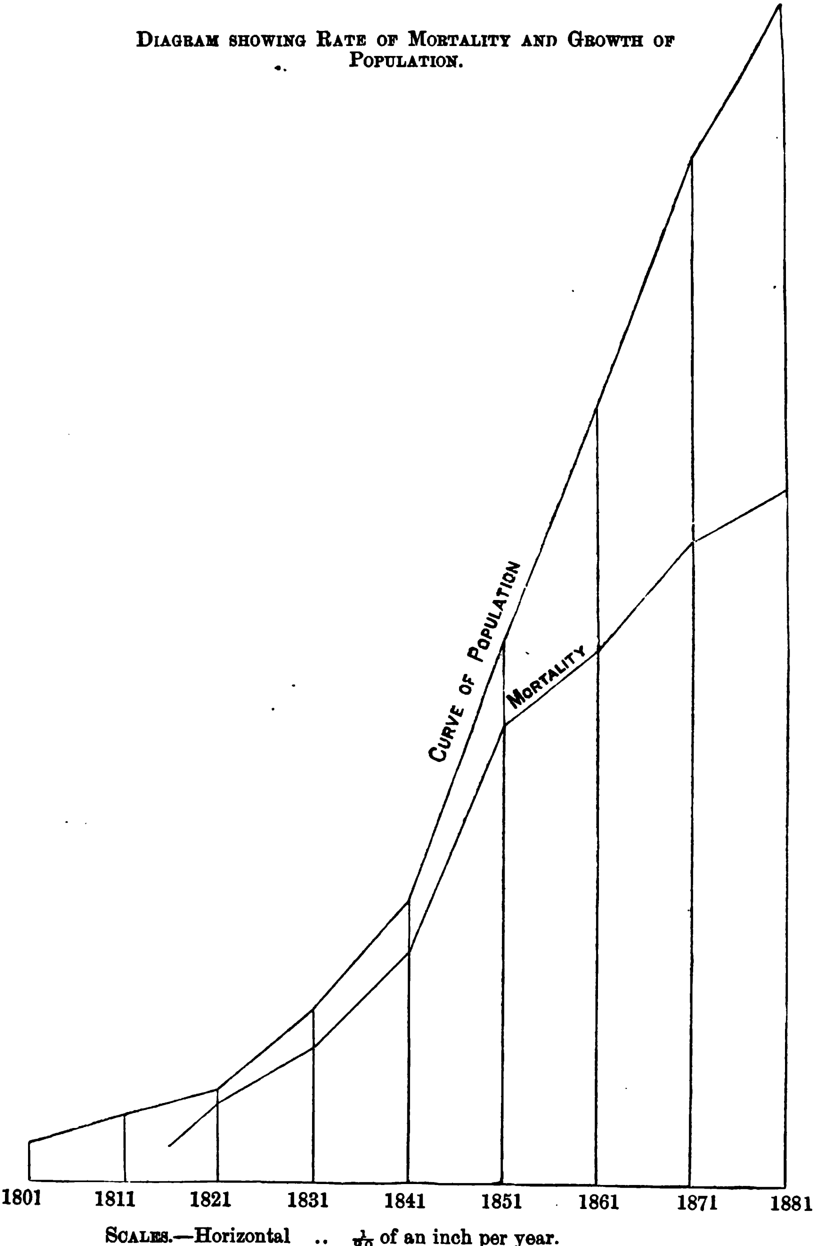
are of special interest as showing various systems of sea-wall construction. In Torbay Road the portion built of red sandstone is very thin, some points not exceeding 18 inches, and the mortar is made from common lime. For a considerable distance it rests upon a bed of peat of unknown thickness; the original foundations are about 2 feet above the lowest part of the pitched foreshore. The concrete underpinning and casing was executed in 1882, it is carried down about 4 feet below the lowest part of the foreshore, and is from 3 to 6 feet in thickness. The rough portion of the wall near the Torbay Road Gardens is built of large rough blocks of limestone, carefully bedded, and jointed from the face about 6 inches, and set without mortar of any kind; it stands well and gives little or no trouble for repairs.

At Cary Green the wall is simply face-work, one stone thick, and backed with small rubble somewhat larger than road metalling. The stones are all squared and set in lias lime mortar. The wall owes its strength almost exclusively to its form, the vertical portion having suffered injury to such an extent, that last winter it became necessary to take down and rebuild a length of about 30 feet.

The natural characteristics of the climate, are the absence of the extremes of heat and cold, rarely rising to 80° Fahr. in summer or falling below 28° in winter. Snow is almost unknown; the rainfall is moderate in amount and takes the form of tropical storms, a large quantity falling in a very short time, effectually purifying the air, washing the roads, and flushing the house-drains and sewers.

The prevailing winds are west and south-west, and these, from the almost insular position of the town, are tempered and modified by the sea. As a result the mortality is small even for a

DIAGRAM SHOWING RATE OF MORTALITY AND GROWTH OF POPULATION.



SCALES.—Horizontal .. $\frac{1}{20}$ of an inch per year.
Vertical .. .. $\frac{1}{4}$ „ „ per 1000 for population.
„ .. .. 1 inch per 100 for mortality.

residential town, and especially so when it is observed that there are four institutions taking consumptive patients from all parts of England, as well as an infirmary which admits accidents from a large surrounding district.

During the day a large number of places of interest were visited, and it was decided to discuss en route the various matters described in the paper as they came under observation. The Members visited the sea wall at Meadfoot, the steps being specially noticed. The end blocks forming these steps are about 5 *feet by* 2 *feet by* 1 *foot, and* 3 *feet by* 2 *feet by* 1 *foot* 6 *inches alternately, and two complete steps are worked out of each stone; the system has so far answered well, no damage having been done to them by the heavy gales to which these steps are exposed.*

After visiting Ansty's Cove, the Members inspected the Marble Works of Messrs. Blackler and the Terra-Cotta Works of Messrs. Ball at Watcombe, and afterwards the grounds of Watcombe Park, by the invitation of Colonel Wright, where the whole of the trees were planted by the late F. K. Brunel, and comprise almost all known varieties of firs and pines. The Members were most generously entertained by Colonel Wright.

DISTRICT MEETING AT LEEDS.

November 8th, 1884.

Held at the Offices of the Borough Engineer, Leeds.

Mr. W. G. Laws, *President, in the Chair.*

Mr. J. W. Horsfield was elected Honorary Secretary for the Yorkshire District.

SEWERING TOWNS ON THE SEPARATE SYSTEM.

By THOS. HEWSON, M. Inst. C.E., Borough Engineer, Leeds.

The subject upon which I have promised to make a few remarks this morning is practically a new one. It is only within very recent years that two systems of sewering towns have been heard of. Until then, one sewer sufficiently large for a reasonable rainfall and the sewage was considered full provision for the draining of a town. Of late years, however, from other necessities which have arisen, the separate system of sewers has been introduced—in one or two towns wholly, in many partially; and in most others it has been talked of. This system consists of a sewer sufficiently large for the rainfall only, and another sewer sufficiently large for the sewage only. My remarks naturally begin with the question of what has given rise to this innovation? In looking round for an answer I am struck with two facts. First, that towns on tidal rivers or on the coast do not even discuss the separate system of sewers. On the other hand, inland towns one and all either regret not having adopted the separate system, or are being induced to do so, and all of these are from local necessity compelled to purify their sewage. Thus we have some sort of guide; for we have one class of towns never dreaming of the separate system, and another class practically having it imposed upon them. It would seem, therefore, that this system of sewers has had its birth out of the necessity for the purification of sewage. Is, then, the separate system better than the combined one, where a system of purification has to be adopted? The answer always given is, It is cheaper, for—(1) there is the smaller cost of the outfall sewer; (2) the smaller quantity of liquid to be dealt with, and (3) the smaller annual cost for purifying and, it may be, pumping. To ascertain the merits of the two systems it is evidently essential to know (1) are these results of the separate system true; (2) are there any consequent expenses as set-offs against this saving; (3) is there any difference in the sanitary value of the two systems, and if so is the change from the combined system to the separate system for the better or for the worse, and (4) can the saving in outfall sewer and sewage purification accomplished by the separate system be effected without a duplicate system of sewers in a town? Now as to the first proposition, there is no doubt whatever that it is true. The separate system of keeping the rainfall entirely out of the sewage sewer needs a much smaller outfall to the sewage works. As to No. 2 proposition, there are great consequent expenses as set-offs against the saving of the separate system. Under this system two sewers are required in every street, and two drains from every house. Now, in order to arrive at the money result of having to lay two sewers instead of one, it is necessary to ascertain the relative size of the two sewers in the one system, compared with the size of the single sewer in the other system, and the respective duties which have to be performed. Taking a combined street sewer (not main sewers receiving one or more street sewers, or intercepting sewers) with the duty of having to deal with 1 inch of rainfall per hour, I find that each acre would yield 3630 cubic feet. Now taking 100 persons as the density of an acre, at 20 gallons water supply per day, and flowing at the rate of 40 gallons mid-day, I find the necessity for sewage provision to be 26·6 cubic feet per hour, or only $\frac{1}{136}$ of the provision to be made for rainfall. These figures show at a glance that a combined sewer built to carry off the rainfall is not in practice made any larger by reason of having to carry off the sewage. It may be said that the provision of 1 inch of rainfall is too great for street sewers to have to provide for. I must, however, point out to the meeting that I am comparing *street* sewers on the two systems—not main sewers—into which several other street sewers discharge. Nor am I speaking of an intercepting sewer which has to carry, it may be, the sewage of hundreds of acres. But I am speaking of street sewers which are bound to carry the whole of the rainfall for the lengths that are tributary to them. Besides this, I must point out that by *making provision* for the inch of rainfall, I mean that the sewer itself shall be capable of properly receiving and conveying so much of 1 inch of rainfall per hour as will find its way to such a sewer. In other words, it is well known that not more than from 50 to 75 per cent. of the rainfall of an hour will find its way to the sewer to which it is tributary within that hour, and therefore, as in making theoretical calculations for the sizes of sewers, the depth of flow is only taken as two-thirds, I find in practice that when making the calculation of half an inch I am really making provision for the inch, which I have given in determining the relative quantities of sewage and rainfall. Coming back, then, to the consequent expenses of the separate system, it is clear that on that system the sewer for rainfall must be as large as the single sewer of the combined system. It follows, therefore, that the *sewage* sewer of the separate system is entirely an additional or extra cost over the combined system. Now as to the house drainage on the separate system, it may be said by some that the rainfall from the backs of houses, backyards, &c., need not be calculated in the rainfall sewer, but may be allowed to run into the sewage sewer, and so do away with the necessity of having two separate drains to the houses. Others may say that the separate system does not involve a separate drain to each house, though it may require a separate drain to each block of houses. With regard to the former I have to tell this meeting that some time ago I went to a great deal of trouble to ascertain the proportion of street area to the total area of a complete urban district, and I found it to be one-tenth of the total area of such district. Now, adding to this one-tenth the fronts of the respective properties abutting upon the streets, on the supposition that the rainfall from them would fall to the streets and be carried to the sewers, it must be seen that, in omitting the rainfall drainage of the back premises, you leave seven-tenths of the total rainfall in the sewage sewer. In these circumstances, I ask, what has become of the separate system? Where is the reduction in the size of the outfall sewer consequent on the prevention of the rainfall from entering that sewer; and what of the great saving at the works of purification? Clearly, the separate system in such circumstances would be a misnomer and a snare. As to the latter contention, that each house need not have a separate drain, clearly additional drainage for the length of each house and a proportion of the drainage to the sewer must, on the separate system, be made. Applying these conclusions to the case of Leeds, I find that the separate system, though making a saving in outfall sewers and in purification, involves as a set-off the following increased expenditure in the town:—200 miles of the sewage sewers, manholes, &c., at 10*s.*, 176,000*l.*; 60,000 house drains, at 1*l.*, 60,000*l.*; extra, for flushing sewers, nil; double cost of repairing and maintenance, nil; total, 236,000*l.* Now compare this set-off of increased expenditure with the saving of the separate system In a gravitation scheme the separate system does not shine out at its best, for in such a scheme the only saving in the purification works is in the extra chemicals required by the combined system for wet days. For, though wet days, it may be said, add only pure water to the sewage, still, as a matter of fact, the increased bulk, to be dealt with satisfactorily, would have to have some increase of the chemical precipitants, and this if for no other reason than that on the combined system the largely increased bulk of sewage brings about a greater state of unrest in the tanks. Now in a pumping scheme the separate system gives its greatest saving, for all additions due to rainfall in the combined system are prevented by the separate system, and the double or treble cost of pumping during wet days on the combined system stands as credit to the separate system, for on the combined system pumping must be continued until the sewage is sufficiently diluted to be discharged into the natural water-course. Putting these views in figures as they would apply to Leeds, I find as follows:—Treble pumping for fifty days, lift of 18 feet, at 400*l.* per annum, twenty-five years' purchase, 10,000*l.*; engines, with margin and being made in duplicate, no extra expense; saving on outflow sewer, 1 mile in length, 4*l.* per yard, 8040*l.*; chemicals necessary for increased bulk on wet days, treble lime, at 12*s.* 9*d.* per ton for fifty days, twenty-five years' purchase, 15,000*l.* These make a total of 33,040*l.* Thus, then, the second question is answered for Leeds, which has all the temptations to adopt the separate system. The separate system would cost 202,960*l.* more than the combined system. And this excess in favour of the combined system would of course increase as population increases, so that a comparison, in some ten or fifteen years from now, would no doubt bring the saving up to over 300,000*l.* Now, with such a result as this, so easily ascertained—so palpable—one cannot help asking how it is that engineers recommend the separate system ninety-nine times out of every hundred that they are called in to advise as to works of purification and outfall. I have already said, and from your practical knowledge, you all know, that *these* works, in the very nature of things, must be cheaper when the town is sewered on the separate system, than when sewered on the combined system; so, as the consulting engineer's report is limited to the purification question, he recommends to the local authority the cheapest process. The seven-fold increased cost of sewering the town is not within his purview. That question is left to be dealt with by the corporation—*at some future period.* The saving in the purification works (which for the most part are compulsorily made) is palpable and immediate. The increased cost of sewering the town consequent on the adoption of the separate system is not gone into. It is not known. There is a general hazy admission that it would be something larger than it would have been on the combined system, but the haze is so thick, and the time so remote when it will be dispelled, that it is, as before said, not gone into. In the future, and whenever some more determined character than usual tries to pierce this haze, it is pointed out to him that in the case of all new streets, and in the case of all new house-drains required after the introduction of the separate system, the cost will fall upon the owners of property, and so not appear in the books of the corporation as a set-off against the saving in the purification works. The 100,000*l.* or so which property owners have paid and will have to pay for many years appears in the ledgers of the corporation as debits against these persons and not against the separate system of sewering.

As to the third point: Is there any difference in the sanitary value of the two systems, and if so, is the change from the combined to the separate system for the better or for the worse. Whilst much can be said against the sewage sewer of the separate system on sanitary grounds, I have never yet heard but one tangible objection to the combined sewer on these grounds. That objection is that, under that system, the dry weather flow of sewage is so small and spread over so large an area, that the velocity of flow is so reduced as to allow a deposit which the smaller-sized sewer carrying the same bulk of sewage would not allow. This idea is utterly fallacious, for it is built upon the assumption that the form of the invert of the large sewer of the combined system must present to the reduced flow of sewage a larger area than the sewage sewer of the separate system. I submit this is not so, and in answer to this objection would simply point out that if the large combined sewer were constructed with a sunk invert corresponding to the lower half of the size of sewer necessary only for sewage, you will have in a combined sewer what the word really means—you will have a sewer for rainfall with all the advantages of size, and you will have a sewer for sewage with its small dimensions and high velocity preventing deposit. The following passage occurs in a paper bearing upon this point, and I will therefore read it:—

"In the combined system you have one sewer flushed by every rainfall; in the dual system you have two sewers, one for the rainfall and the other for sewage and subsoil water. The latter by reason of the abstraction of the rainfall requires annual expense for flushing—a work never satisfactorily attended to, and if it were it is not possible to purify such sewers so well as by the rainfall, consequently more sewage gases will generate in them than in that of the combined system, for dilution tends to lessen the putridity of the sewage. Again, supposing two sewers in a street, and two sets of drains from each house on each side of such street, the foul-water drain communicating with one, the surface-water drain with the other. Under such circumstances it would be almost impossible to prevent builders and workmen from entering the sewers with their drains indiscriminately. Moreover, if the duplicate sewers were not absolutely watertight, and the subsoil also watertight, the fluid in one sewer would by filtration and percolation act and react upon the other sewer."

As to the fourth question: Can the saving in outfall sewer and sewage purification accomplished by the separate system be effected without a duplicate system of sewers in a town? So far I have been speaking generally of the two systems as understood, and so, in the comparison as to money cost, I have assumed the separate system involved a double system of sewers in a town. Now whilst I have done so for the purpose of making a comparison, I contend that, if cases were very minutely examined, double systems of sewers would very rarely be required. Thus in some towns you may construct on each main sewer from the uplands a leaping-weir and storm-outfall sewer, the weir a little higher than the highest flood level of the river, thus only leaving along the bottom of the valley a low zone of rainfall tributary to sewers which lie below the flood level of the river. In towns with quick uplands the rainfall due to the area of this low zone will not equal the bulk of the sewage from the whole of the uplands. It follows, therefore, that in a rainfall, simultaneously with the demand of the rainfall upon the low zone sewers, those sewers would be relieved of the sewage of the uplands by means of the leaping-weirs. Thus the object of the separate system without a duplicate system of sewers could be accomplished in such a case, for although the actual liquid passing along the intercepting sewers in the low zone would not be entirely sewage, as in the case of the sewage sewer of the separate system, yet it would not be more in bulk, which goes to the real question of cost. Now, in towns with flatter uplands and larger area of low zone, and which, at a distance from the town and without flooding premises, would admit of the sewage being backed up into the adjoining river, a self-acting float-box and valve working on multiplying wheels can be so placed as to divert the diluted sewage bodily into the river at the moment when the sewage has attained the degree of dilution determined on. (The author here exhibited a type drawing of several he had constructed.) In this case it must not be supposed that I propose to bring the whole of the rainfall to the valve-chamber, for I would place leaping-weirs and their arrangements to divert the rainfall of the uplands to the river as in the other case, so that at the valve-chamber I shall only have to divert into the river the diluted sewage of the low zone. Thus, excepting in the rare case of sewage works close to a town, involving a short length of outfall sewer and very flat gradients, I have shown that the separate system does not, in most cases, require double sewers in a town; and in the rare case here named, I have already shown that a single system of sewers in a town, whilst requiring a larger outfall sewer, and increasing the cost of purification, saves seven times this expense in the sewering of the town. I hope that the last few remarks which I have made will not leave the minds of the meeting, as the money comparison which I have made is with the separate system as it is practised and as it is proposed. I have a strong conviction that the engineering world is very culpably allowing the separate system to assume definite lines and forms without a detailed examination of the nature and cost of the consequent works. Local authorities, pestered by riparian owners, forced after much resistance to move more quickly than willingly, apply to engineers for relief from their difficulties. Engineers, like lawyers, advise on the case submitted, but I am sure that if their clients have no notion that a duplicate system of sewers in a town costs more than the saving in purification by the separate system, civil engineers employed by them should inform them of the fact. I say that the separate system as understood (and not on the lines which I have suggested would do away with the necessity of double sewers), whilst decreasing the cost of outfall and purification, increases the cost of sewering a town by seven times the amount of that saving, and that, too, even when the combined system is carried out in all its enormity. I maintain this aspect of the question, too, in regard to any partial adoption of the separate system. I am of opinion that a perfectly separate system carried out in a town could never be maintained, but would be ruptured and disordered and be altogether a misnomer five years after its completion, for contractors, builders, and gas and water companies would be perpetually interfering with the system and making it conform to their objects. As to the sanitary aspect of the question, I believe that the concentration and terrible pungency of the gases arising from small-sized sewers carrying sewage only hurt the health of a town more than the gases from large combined sewers where the subsoil water and rainfall retard putrefaction and the smaller quantity of gases coming off are diluted with air from four to twelve times as much as they can be in the sewage sewer of the separate system.

Mr. **Gordon** explained the nature of the works being carried out at Leicester for the purpose of preventing flooding in the low-lying districts, and illustrated by means of a chart the system which had there been adopted for gauging the extent of rainfall in the sewers. The chart was similar to that used by water engineers for registering the height of the flow during periods of twenty-four hours.

Mr. **Knowles** approved of the system of leaping-weirs for upland rainfall, but was of opinion that the low zone having the rainfall to carry would have to have larger sewers for that purpose.

Mr. Cox, Mr. Platt, Mr. Fowler, and Mr. Hague, also took part in the discussion.

EXAMINATIONS BY THE ASSOCIATION.

The **President** asked attention to a matter affecting the general welfare of the Association, and referred to Mr. Angell's bringing under the notice of the meeting held in the Health Exhibition the question of the Sanitary Institute and the examinations of surveyors as proposed by that body. He considered that if these examinations were wanted there was no body like the Association of Municipal Engineers that could better judge of what was required, and therefore the Association should institute these examinations. He thought that the Association should apply for a Royal Charter to include powers to hold these examinations. The immediate result would be, that those who were anxious to attain the position of a borough engineer or surveyor would conclude that they had better connect themselves with this Association, and its numbers would thereby double in a very short time. He should bring the matter before the Council, but in the meantime requested that the Members would think the matter over, so that he should receive their support if he brought the matter forward at the next meeting.

Messrs. Gordon, Hewson, and Fowler also spoke on the subject.

The Members were subsequently taken to Knostrop, where they inspected the Leeds Sewage Works, and to Burmantofts, where they examined one of the Refuse Destructors of the Corporation.

LEEDS SEWAGE WORKS.

Excerpt Pamphlet, by T. HEWSON, M.I.C.E., Borough Engineer.

Experiments in Purification.

It may be interesting to review what has been done by the Leeds Corporation respecting the purification of the sewage.

In 1870, the Corporation, considering that the process of the Native Guano Company offered the best means of purifying the sewage and obtaining some return for the expense by the sale of the manure, entered into a contract with that company, and performed their part of such contract in erecting the experimental works, in accordance with the plans prepared by the company's engineer. Accordingly, in the beginning of October 1871, the Native Guano Company commenced to purify about 1,000,000 gallons of sewage daily, and they obtained a very excellent effluent, bright and clear, and free from smell or taste. They continued doing this until the new works were nearly completed, but the expenses had been far greater than had been expected, and it was difficult to sell the manure at a remunerative price; moreover, the company apparently feared to incur the large liability to which they would be exposed if they commenced treating the whole of the sewage at the new works.

As the management of the old works was entirely in the hands of the company, the Corporation does not know what the purification really cost them; but from the best information obtained, the ordinary quantity of materials used to purify 1,000,000 gallons of sewage was:—

	Tons	Cwts.	Qrs.	Lbs.
Alum	2	13	1	0
Carbon*	2	0	0	0
Clay	3	6	2	12
Blood mixture	0	0	2	0
Lime	0	1	2	18
Total	8	2	0	2

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* The carbon is animal carbon, being refuse from prussiate of potash works.

costing, say 7*l.* 5*s.* per million gallons; and if 9,000,000 gallons had been purified, the cost for ingredients would have been 2*l.* 16*s.* per hour.

According to Sir J. W. Bazalgette's report, at Crossness the ingredients used to purify about 12,000,000 gallons of sewage, in the months of August, September, October, and November, 1872, weighed about 166½ tons, and cost 293*l.* 16*s.* 10*d.*, being at the rate of 24*l.* 9*s.* 8*d.* per million gallons, whilst at Leamington it cost 15*l.* 18*s.* per million.*

On the 14th March, 1873, the company gave notice that they were not in a position to continue the working of the process and dealing with the sewage at Leeds, and after considerable discussion the Corporation agreed to release the company from their contract upon condition that they were allowed to use all or any of the company's patents, free of royalty. Accordingly, on the 1st of June, 1873, the Corporation took possession of the experimental works, and shortly afterwards invited any persons who wished to make experiments to do so, the Corporation lending the works and machinery free of cost, and the experimenters finding coals, labour, and the required ingredients.

In September and October, Mr. Sylvester Fulda made a trial, and afterwards General Scott experimented, and showed that he could manufacture a very good cement from the sludge. Mr. Rupert Goodall, of Armley, near Leeds, was the next to apply his process, combining the use of lime, animal carbon, ashes, and an iron liquor, which he called sesqui-persulphate of iron. His experiment was so far successful that he formed a company, called the Leeds Clarifying and Utilization of Sewage Company, and in June 1874, the Corporation agreed that Mr. Goodall's company should work their process in the new permanent works, and on all the sewage for three months; but as the new works were not ready so soon as was expected, the time was extended to a further period of three months from January 1, 1875, and the result of his experiments was that he produced a good effluent at a cost of about 16*s.* 6*d.* per hour *for ingredients* to treat the whole of the sewage of the town passing in that time, and taking this quantity at 9,000,000 gallons in twenty-four hours, the cost would be 44*s.* per million gallons.

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* See a paper by Mr. W. Shelford, on the 28th March, 1876, read before the Institution of Civil Engineers.

The quantity of materials used daily to obtain the above effluent were:—

	Tons	Cwts.
Lime	21	15
Carbon	13	15
Ashes	10	14
Iron liquor	0	4
Total	46	8

There is no analysis of the effluent water answering to the above quantity of materials used, but at the experimental works, in December 1873, by the use of the following ingredients, 800,000 gallons of sewage were treated, and an effluent produced which was analysed by Mr. Fairley. The ingredients used were:—

15 cwt. of lime.
15 „ of carbon.
1 carboy of iron liquor.

MR. GOODALL'S EFFLUENT ANALYSED BY MR. FAIRLEY IN FEB. 1874.

	Per cent.
Mineral matters, consisting of chlorides, salts of lime, magnesia, alkalies, &c.	40·75
Volatile and organic matters	9·72
Total dissolved solid matter	50·47
Containing chlorine	7·93
Equivalent to common salt	13·11
Containing ammonia	0·574
„ albuminoid ammonia	0·30
Equivalent to nitrogenous organic matter, about ..	3·00

The undried residuum contained:—

			Lbs. per Ton.
Moisture	68·95	..	1544·5
Organic matter	5·65	..	126·6
Phosphate of lime	6·40	..	143·4
Sulphate of lime	2·38	..	53·1
Carbonate of lime	2·90	..	67·0
„ of magnesia	3·04	..	68·1
Oxide of iron	2·07	..	46·4
Alumina, alkalies, &c.	0·12	..	2·7
Silicious matter	8·40	..	188·2
	100·00	..	2240·0
Containing nitrogen	0·13	..	2·91
Equivalent to ammonia	0·156	..	3·49

The Native Guano Company hearing that Mr. Goodall* had found that he could purify the sewage in large quantities in the new works at a much cheaper rate than at the old experimental works, were desirous to make trial to see whether they could not also cheapen their process. Accordingly, in June 1875, they commenced working, and by making an alteration in the formula by reducing the quantity of alum and using a very much larger quantity of lime, they, in August 1875, obtained a very good effluent, which was analysed by the late Dr. Letheby, as follows:—

CONSTITUENTS PER IMPERIAL GALLON.

	Grains.
Actual or saline ammonia	1·207
Ammonia derivable from organic matter ..	0·147
Nitrogen or nitrates	0·000
	1·354
In Solution.	
Carbonate of lime and magnesia	13·70
Sulphate of lime	14·28
„ of magnesia	10·78
Alkaline sulphates	3·99
Chloride of sodium	11·79
Phosphoric acid	trace
Organic matter	4·59
Total dissolved	59·13
In Suspension.	
Organic matter	0·32
Mineral „	0·22
Total suspended	0·54

The amount of oxygen required for the oxidation of the organic and other oxidizable matters in solution was 1·28 grain per gallon.

Under the microscope the suspended (or insoluble) matters were found to consist of amorphous mineral matter, with filaments of sewage fungus and particles of vegetable tissue.

These results show that the effluent water is a good sample of defæcated sewage, and that if exposed to the air, instead of being corked up in a bottle for several days before I received it, it would have been inoffensive and admissible into a running stream which is not used for drinking purposes. It fulfils in fact the conditions required by the Conservators of the River Thames for the effluent water which is admissible into the river Thames below Teddington Lock.

October 12, 1875. (Signed) H. LETHEBY.

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* Mr. Goodall read a Paper before this Association at the Annual Meeting at Manchester in July 1875, and it was printed in vol. ii. of the 'Proceedings,' p. 45.

The following analysis of the dried residuum from the process of the Native Guano Company was made by Professor Voelcker, June 2, 1876 :—

	Per cent.
Moisture	24·53
Organic matter and water of combination ..	20·39
Oxide of iron and alumina	14·23
Phosphate of lime	1·66
Carbonate of lime	11·98
Sulphate of lime	1·88
Alkaline salts and magnesia	1·95
Containing 0·45 of potash and insoluble silicious matter	23·38
	100·00
Containing nitrogen	0·43
Equal to ammonia	0·53

The materials used per day of twenty-four hours to obtain this effluent and residuum were on an average of nine days and nights :—

	Tons	Cwts.	Qrs.	Lbs.
Lime	7	2	3	2
Animal carbon	6	1	0	4
Norris's alum	3	12	0	12
Clay	7	10	1	20
Carbolic sulphite*	0	0	0	27½
Total	24	6	2	9½

costing 21*l.* 19*s.* 5*d.*; equal to 18*s.* 3¾*d.* per hour, or taking the total daily quantity at 9 million gallons, the cost would be 2*l.* 8*s.* 10*d.* per million.

In a trial made for a week in January 1876, the following materials were used upon the average during each twenty-four hours :—

	Tons	Cwts.	Qrs.	Lbs.
Lime	6	13	3	20
Carbon	8	6	0	24
Spence's alum	5	6	1	4
Clay	11	2	1	4
Carbolic sulphite	0	0	0	5½
Total	31	8	3	1½

costing 29*l.* 11*s* 9*d.*; equal to 1*l.* 4*s.* 8*d.* per hour, or on a total

daily quantity of 9 millions of gallons 3*l.* 5*s.* 9*d.* per million gallons.

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* The powerful effect of this material was shown by the fact that although only a thin thready stream of liquor was allowed to flow into the sewage at the end of the delivery pipe from the pumps, if the hand was dipped into the effluent water at the last tank the smell of carbolic acid could be detected.

Towards the end of 1875, Mr. John Hanson, of Dewsbury, patented a process for sewage purification, and the Corporation arranged with him to try what he could do with the whole of the sewage; after several trials he succeeded with the following materials in producing a very good effluent. In twenty-four hours he used:—

	Tons	Cwts.	Qrs.
Lime	20	0	0
Black ash	4	0	0
Red hæmatite and double B.O.V. ..	1	6	2
Total	25	6	2

costing 20*l.* 11*s.* 2*d.*; equal to 17*s.* 1½*d.* per hour, or taking the total quantity in twenty-four hours at 9 millions of gallons, the cost would be 2*l.* 5*s.* 8*d.* per million.

An analysis of the effluent obtained from the above materials was made on the 1st April, 1876, by Mr. Thomas Fairley, the Borough Analyst, and is as follows:

It contains in grains per gallon:

	Grains.
(1) Mineral Matter, consisting of chlorides, salts of lime, magnesia, alkalies, &c.	42·24
(2) Volatile organic matter	3·68
Total dissolved solid matter	45·92
(1) Containing chlorine	4·62
Equivalent to common salt	7·79
(2) Containing ammonia	0·40
„ albuminoid or organic ammonia ..	0·14
Corresponding to nitrogenous organic matter, about ..	1·40

Professor Voelcker's analysis of residuum from Mr. Hanson's process, June 2, 1876, is as follows:—

	Grains.
Moisture	23·17
*Organic matter and water of combination	20·38
Oxide of iron and alumina	12·28
Phosphate of lime	0·98
Carbonate of lime	26·86
Sulphate of lime	4·21
Alkaline salts and magnesia (containing 0·26 of potash)	2·63
Insoluble silicious matter	9·49
	100·00
*Containing nitrogen	0·45
Equal to ammonia	0·55

Mr. Hanson, from experiments since made, asserts that he can dispense with the hæmatite, and obtain an equally good effluent by the use of lime, black ash, and brown oil of vitriol, and consequently at less cost. Towards the end of April Mr. Hanson's process was discontinued. Lime only, without any other ingredients, was then tried for a fortnight; this could not extract the dye from the sewage, and the effluent was therefore occasionally discoloured.

The Native Guano Company then applied to be allowed to experiment with a cheaper description of alum made by Messrs. Spence, of Pendleton, and these experiments were made in July 1876. The results were satisfactory as to the effluent, but again the cost of chemical precipitants and the inability to sell the resultant manure were not satisfactory to the company.

It will be seen that the three processes described are chiefly dependent upon lime, but with the addition of alum, carbon, iron, and acid, principally to destroy the colour from the dye.

It must be noted that the Native Guano Company in other places (chiefly water-closeted towns), and in their earlier experiments at Leeds, where, as has been stated, there are but few water-closets, used little lime but a very much greater quantity of alum. In July 1876, in Aylesbury, a water-closeted town, they used, to purify one million gallons:—

	Tons	Cwts.	Qrs.	Lbs.
Alum	1	17	0	0
Clay	2	14	1	0
Blood	0	1	0	14
Charcoal	1	4	0	0
Lime	0	4	1	19
Total	6	0	3	5

In addition a small quantity of carbolic sulphite was used.

PRESENT PROCESS, &c.

Since this time the Corporation have had no experiments, and the precipitant used has been lime only. It is from Ribblesdale, near Settle, Skipton; it is slaked, i. e. not slutched, and screened, and then as a powdered hydrate is ground into a milk of lime. The quantity of lime used is about one ton per million gallons of sewage. The effluent is most satisfactory, the discoloration from dye being only periodical, and then very slight—the drying of the sewage sludge in heated cylinders, cost about 4*s.* 6*d.* per ton, but as there was no market for it at this increase of price, this process has been discontinued, and now, after the sludge has become dry enough in the mud tanks to be spaded and barrowed, it is removed to the adjoining bank of the river, from whence after drying to the condition of ordinary garden mould, it is sent away per boat and cart. Under these conditions we are able to prevent accumulation, except during the summer months. The analysis of the dried sludge as now sold, is as follows:—

Analysis of a Sample of Sewage Mud received from Thomas Hewson, Esq., C.E., 17th September, 1884.

The sample contains in 100 parts:—

	Moisture	46·94
(1)	Organic matter and salts of ammonia	14·80
(2)	Phosphates of lime, magnesia, &c.	traces
	Silicious matter	6·48
	Sulphate of lime	1·12
	Carbonate of lime, alkaline salts, &c.	30·66
		100·00
(1)	Containing nitrogen	0·92
	Equal to ammonia	1·12
(2)	Containing phosphoric acid in the soluble form equal to soluble phosphate	none

September 24th, 1884. **Thomas Fairley.**

The quantity of fluid sludge pumped from the tanks daily averages 120 tons. This quantity yields 25 tons of *dried* manure, i. e. ready for sale and having 46·94 of moisture.

The sewage sludge largely accumulated so long as any charge was made for it, but no charge is now made, and farmers remove all we make.

The number of men employed upon the works, and their duties, are as follows:—

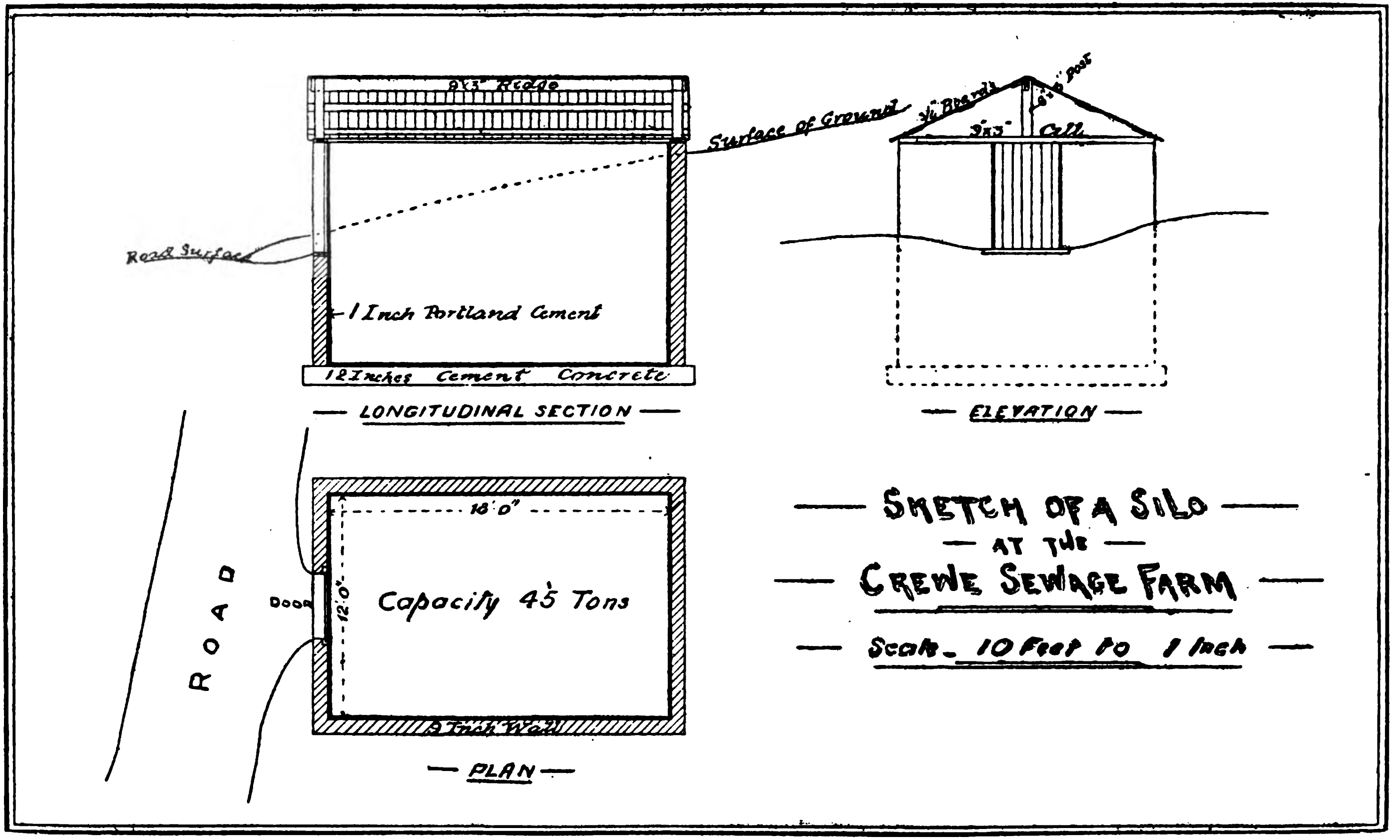
Manager	1
Engine drivers (one night, one day)	2
Firemen (one night, two day)	3
Cleaner	1
Foremen of mixers (one night, one day)	2
Men taking materials to hoist, and in grinding-room, in daytime	5
Men taking materials to hoist, and in grinding-room, at night, and cleaning tanks during the night stoppages	4
Man slaking lime	1
Men wheeling sludge, and manure, &c.	10
Carpenter (repairing barrows, shoots, &c.)	1
Blacksmith, Painter, and Handy Man	1
Total	31

The price of lime delivered is 12*s.* 9*d.* per ton. The lime is analysed when dry to contain 98 per cent. of pure lime. The price of coal—Best Nuts—delivered is 7*s.* per ton.

The Revenue account for the year ending 1884, is as follows:—

COST OF SEWAGE WORKS FOR YEAR ENDED 31ST AUG., 1884.

	£	s.	d.	£	s.	d.
PUMPING:—						
Wages	365	12	0			
Coal	322	1	7½			
Pumps, Repairing	149	19	6			
Oil, Paint, and Tallow	51	15	4			
Iron Bars, Piping, &c.	30	4	5			
Repairs	14	0	0			
Leather, Valves, &c.	27	4	0			
Lubricators	17	4	0			
Brushes and Matting	4	8	11			
Blanketing	2	0	0			
				984	9	9½
PURIFICATION:—						
Lime	1179	2	1			
Wages	1782	5	9			
Coal	93	0	4½			
Oil, Paint, and Tallow	25	17	8			
Iron Bars, Piping, &c.	20	0	0			
Repairs	15	2	0			
Lubricators	5	0	0			
Brushes and Matting	2	0	0			
Trap Hire	21	2	0			
Timber	13	4	0			
Wire	11	1	0			
Water-boots	10	4	0			
Hose, &c.	7	13	0			
Medical Officer	5	17	2			
Office Concreting	4	16	0			
Grass Clipper	1	16	0			
				3198	1	0½
Rent, Rates, and Taxes				757	17	2
				£4940	8	0

9"x3" Ridge
Surface of Ground
½" Boards
6"x6" Post
9"x3"
Coll.
Road Surface
1 Inch Portland Cement
12 Inches Cement Concrete
— LONGITUDINAL SECTION —
— ELEVATION —
18' 0"
12' 0"
Capacity 45 Tons
DOOR
ROAD
9 Inch Wall
— PLAN —
— SKETCH OF A SILO —
— AT THE —
— CREWE SEWAGE FARM —
— Scale 10 Feet to 1 Inch —

To face p. 133.

SUPPLEMENTARY MEETING IN LANCASHIRE AND CHESHIRE DISTRICT.

MEETING AT CREWE.

The Third Supplementary Meeting was held in Crewe, on the 22nd November, 1884, when the Members inspected the workshops of the London and North-Western Railway Company and the Sewage Farm.

In 1883 the Corporation caused an experimental silo to be constructed, with a view to improve the quality of the preserved fodder; this silo was built at a total cost of 26*l.*, with walls of common brickwork 9 inches thick, lined inside with cement 1 inch thick, and a floor of concrete 12 inches thick, faced with neat cement. The floor level was placed 9 feet below the adjoining ground instead of on it, to facilitate the filling, &c.; a movable roof of ¾-inch pine-boards, and planks 1½ inch thick by 9 inches wide, to receive the weights used in weighting the ensilage, were provided. The internal dimensions of the silo are as follows:—Length, 18 feet; width, 12 feet; depth, 12 feet; capable of containing 45 tons of ensilage. The silo was first filled in August 1883, and weighted to 119 lb. per square foot. It was left weighted until December in the same year, when it was opened, and upon examination the ensilage was found to be of excellent quality, that practically no loss has taken place from either mouldiness or any other cause, and was a great success as far as ensilage was concerned. The cost of filling was 2*s.* 8*d.* per ton.

The abattoirs and market were inspected; these cover an area of 3½ acres, and accommodation is afforded for 2000 head of cattle, 6300 sheep, 450 pigs, and 220 calves: the pens for the sheep and calves, and also for 300 sheep, are covered over; there is a covered lairage for 225 cattle. The whole area of the yard is paved with 4-inch grit cubes from Hendon quarries, grouted with chippings and run in with asphalte, except the sheep-pens which are grouted with Portland cement. The lairages, slaughter-houses, &c., are built in common red brickwork and roofed with corrugated sheet iron with light wrought-iron principals.

DISTRICT MEETING AT BURNLEY.

April 25th, 1885.

Held in the Council Chamber, Burnley.

Mr. R. Vawser, *Vice-President, in the Chair.*

The Chairman signified his wish to be relieved of the duties of Hon. Secretary for the Lancashire and Cheshire District. Mr. Creer proposed Mr. S. S. Platt of Rochdale as his successor. This was seconded by Mr. Mitchell and carried unanimously.

Mr. **Platt** in accepting the office hoped that he would receive assistance from his predecessor in carrying out the duties of District Secretary, and he would do his best in every way to promote the best interests of the Association.

Mr. **Stafford** proposed a cordial vote of thanks to Mr. Vawser who had carried out in such an efficient manner the duties of Hon. Secretary of this District since its formation. This proposition having been duly seconded and unanimously carried, Mr. Vawser spoke of the deep interest he had always taken in the Association and of the reluctance with which he gave up the office. Under the circumstances of holding another position in the Association, he thought it was the proper thing to resign the post to another, and he congratulated the Members in their choice of his successor. As preparations were being made for other meetings in the District he hoped to have many opportunities of again meeting the Members.

The minutes of the last meeting were then read and confirmed.

ON THE VARIOUS WORKS IN CONNECTION WITH THE BOROUGH OF BURNLEY.

By J. E. STAFFORD, A.M. Inst. C.E., Borough Surveyor, Burnley.

The Borough of Burnley has a population of 68,500 computed to date, and covers an area of 1,731 acres, with a nett rateable value of 156,313*l.*; and contains about 13,000 houses, about 50 miles of paved streets, 16 miles unpaved, and 10 miles of macadamised roads, making a total of 76 miles of roads, the greater portion of which are lighted by 1,130 public lamps.

The Charter of Incorporation was granted on the 24th of October, 1861. The town is divided into eight wards, and governed by the mayor, seven aldermen, and twenty-four councillors. The works under the Corporation of this borough are divided into separate departments, viz. gas, water, markets, health, cemetery and improvement, each department having its own official and committee; and in order to give some idea of the whole of the works under the control of the Corporation, I have embodied in this paper certain particulars which have been kindly supplied to me by the head officials in the other departments, and I take this opportunity of thanking Mr. Leather, the Gas Engineer, Mr. Waddington, Superintendent of the Markets, and Mr. Williamson, of the Water Department, also Messrs. Waddington and Son, Architects of this town, who have kindly lent the plans for the New Victoria Hospital for the inspection of the Members.

Improvement Department.

This department has under its control the whole of the paving, &c., sewering, road making, bridges, rivers, new buildings, and general street improvements.

Since my appointment here in October 1882, the following works have been executed, viz.:—

About 78,000 square yards of local stone-paving laid, including excavation, under-bed, &c.
„ 24,000 square yards of flagging in footpaths.
„ 15,000 lineal yards of curbing.
„ 16,000 „ channelling.
„ 5,000 „ sewers laid.
„ 50 new manholes built.
„ 600 „ gullies fixed.

The whole of the above work has been executed under notice, as private improvements, and paid for by the property owners. About 15,500 square yards of granite paving on Portland cement concrete foundation have been laid. This granite paving has given great satisfaction, being very durable, non-slippery and clean, though somewhat noisy; and this has led to some discussion in the town as to the relative merits of granite and wood paving, though personally I much prefer the former, for the following reasons:—

1st.—In a town like this with a very heavy traffic, it is much more durable.

2nd.—From a sanitary point of view.

3rd.—From the fact that wood paving requires more attention than granite, hence the latter is much more economical to maintain, though the first cost is a little greater.

A considerable portion of the beds of the rivers Brun and Calder has been pitched or paved, viz. about 4,400 square yards, with a central invert. Plans have been passed for 1,485 houses, 45 lock-up shops, 11 stables, 10 workshops, 2 mills, 8 warehouses, 3 schools, 1 hospital and assembly rooms, and most of these have been erected.

A great number of street improvements have been executed, including the pulling down of considerable property, and the widening of the roadway of the main street, by which alteration the Tramway Company have lately been able to run their cars direct through the town with steam. Two bridges have been erected with approaches thereto, viz: one of 30 feet span and 36 feet wide over the river Calder, and one of 40 feet span and 30 feet wide over the Leeds and Liverpool Canal, and two more are now in hand, each over the canal, being 40 feet and 42 feet span respectively.

The existing municipal buildings being totally inadequate for the requirements of the town, the Corporation have decided to erect new ones at a cost of 30,000*l.* A competition has taken place, and three premiums awarded for the three best designs, viz:—1st. Two hundred guineas; 2nd. One hundred guineas; 3rd. Fifty guineas.

The premiums were obtained by Mr. Holtom, of Dewsbury; Mr. Corson, of Leeds; and Messrs. Natrass & Coward, of London; the first-named gentleman being engaged to carry out the works, the advertisements for which are now before the public.

The new buildings, which are to be erected on the site now occupied by one of the store yards of the Corporation, situate in Manchester Road, will comprise municipal offices, council chamber, mayor's rooms, police offices, cells, two courts, and public baths.

In lieu of the store yard above referred to, the Corporation have acquired a large plot of land about half-a-mile from the centre of the town for that purpose. This land is most conveniently situated, having the L. and Y. Railway on one side and the Leeds and Liverpool Canal on the other, with both of which it is on the level, thus greatly facilitating the discharge of the various materials.

At the Yorkshire Street Store Yard, which is also situated on the banks of the canal, are the "refuse destructor," the "elevator," and the "tool sharpener." The first-named is used by the Corporation for the destruction of all garbage, market refuse, street sweepings, condemned meat, and ashpit contents when required, and has been at work for over eighteen months. The elevator and automatic sieve are employed in connection with the stone-breaking machine, to which they are a great addition, as a considerable saving is effected in labour as well as wear and tear. The tool-sharpener is employed for sharpening tools, picks, &c., not alone for the Corporation workmen, but also for the various contractors, and a great saving in time is thus caused, as this machine, with one attendant, will sharpen forty score of tools per day against nine score by hand.

The next matter is one of considerable interest to all towns, viz. the disposal of sewage. The system adopted here is known as "Scott's cement-making process," and these works deal with about 80 per cent. of the total sewage of the town, or equal to 1,250,000 gallons per day. The sewage is conveyed from the town to the works through a 3 feet by 2 feet egg-shaped brick sewer. Before entering the large tanks it passes through two "catch-pits" which retain certain matter, such as rags, paper, &c.,

and this is given away to farmers for till. Leaving these pits it passes down a "salmon ladder," in which is mixed with it a solution of lime and water—of 1 part lime to 6 parts water; this solution is equal to about ·25 per cent. of the total flow of sewage. From the salmon ladder it proceeds to the settling-tanks, which are in two sets of three to each set; these tanks average 70 feet by 40 feet by 8 feet deep. When a sufficient time has been allowed for precipitation to take place, which is about twenty-four hours after the inflow has been stopped, the top water is run off and the sludge pumped from these tanks into small "becks," but if necessary before pumping a little more lime is added to it, in which it stands about ten days for the purpose of straining; it is afterwards passed through a pug-mill, then spread on a drying-floor, and cut into cakes about 9 inches or 12 inches square and 4 inches thick. When dry, these cakes are burnt with coke in a kiln (the cake being about 15 per cent. of the dried sludge), for thirty-six hours until a clinker is formed. This clinker is crushed in a mortar mill and ground between two stones, the product being Portland cement. The effluent, which is of a fairly clear description, is turned into the Pendle water.

The works, which cover an area of about 5 acres, and cost complete about 47,000*l.*, are in the hands of General Scott's Company, who hold them under a lease for 12 years, about 8 years of which have expired. The Corporation paid the company a subsidy of 1,000*l.* per annum at the commencement of the lease with a yearly increase of 20*l.* This subsidy is equal to 6*d.* per head of the population.

In addition to the system already referred to, we have a supplementary scheme for a population of about 12,000. This comprises 2 sets of tanks, 3 to each set. The sewage discharges into these tanks, and filters through coke-chambers, the effluent eventually joining a small stream which runs to the river Calder. The tanks are cleaned out once every ten days and the sludge given to the farmers.

WATERWORKS.

The Waterworks were acquired in the year 1846, at which time they were purchased by the Local Commissioners from a private company. The first water supply was from the Calf Hey Spring, which was delivered by a common drain into a small reservoir at Pheasantford (now disused), and from thence by a 6-

inch pipe into the town. The consumption at that time was not more than 540,000 gallons per day for all purposes. Subsequently a number of other reservoirs were constructed, the total capacity of which was 190,000,000 gallons, and the daily consumption was 1,750,000 gallons. Owing to the rapid increase in the population of the town and the prosperity of the trade in the district, these works were found inadequate, and the Corporation, after some opposition, resolved to apply for powers to provide an additional supply; these powers being obtained, the necessary work was commenced, and is now in progress.

The following is a description of the new reservoir, which has been kindly supplied by Mr. Williamson, the Water Manager.

THE CANT CLOUGH RESERVOIR.

This reservoir will be in the township of Worsthorn-with-Hurstwood, and about 3½ miles from the town of Burnley, and will be formed by throwing an embankment across the Cant Clough Valley from north to south. The greatest depth of the embankment will be from 80 to 90 feet, and the length about 450 yards; it will contain about 300,000 cubic yards of earthwork, and about 30,000 cubic yards of puddle. The stone toe at the foot of the inner slope of the embankment consists of 20,000 cubic yards of rubble stone. The puddle trench will be about 70 feet deep. The draw-off pipes from the reservoir will be placed at different levels and conveyed through a culvert in the solid ground. At the point where this intersects the puddle trench a massive brick stop-piece will be formed and the pipes carried through it. The reservoir will be used for both compensation purposes and for domestic supply, the capacity being about 266,000,000 gallons, and the gathering ground 1,000 acres.

GASWORKS RETAINING WALL.

(Per Mr. S. P. Leather, C.E., Gas Engineer.)

This wall was built in 1881. It runs along the margin of the river Calder, is 352 feet long and 23 feet high. It was erected for the purpose of levelling the land now occupied by the gasholders Nos. 2, 3, 4. As the tanks for these gasholders are each 107 feet diameter and 23 feet deep, the strength of the wall is required to be such as would bear the thrust of the great weight thus put against it. The distance from outside of retaining wall to inside of tanks is about 22 feet.

Before this wall was built it was known that there was a quicksand in or near the site of the wall, as it had been encountered in the sinking for the tanks. The foundations touch the quicksand at the two ends of the wall, but chiefly at the far end opposite No. 4 tank. The wall was built in a bed of concrete about 12 feet wide, varying from 2 to 4 feet thick, according to the nature of the ground; it had a batter of 1½ inch to the foot, was built of ashlar, with rubble backing, reducing in thickness from 12 feet at bottom to 4 feet at top.

In consequence of a strong wish to get the gasholders at work as early as possible, the filling up behind the wall was done more rapidly than was desirable. The tanks Nos. 2 and 3 when filled were found to leak, which percolating into the foundations doubtless helped the wall to slip. After they had been filled a little over a week, the wall opposite No. 3 tank was discovered, early in the morning of the 28th of November, to be moving into the river at the rate of about 2 inches an hour. This movement was almost entirely stopped before the day was over by logs of timber strutted against the other side of the river, the wall had then moved about 25 inches at the top and 16 inches at the bottom. A number of bore-holes were made to ascertain the nature of the ground below the wall. Opposite No. 3 tank, where it had moved most, there was found to be 8 feet of clay below the toe of the wall, under which was 8 feet of sandy marl, and again 4 feet of quicksand; rock being reached by the borers 20 feet below the bottom of the wall.

At the south end, opposite No. 2 tank, the rock was only 9 feet below the bottom, the quicksand there being about 8 feet thick. At the north end the rock was 24 feet below the wall, the whole distance being quicksand.

It was at once proposed to strut the bottom by means of an invert in the river. The estimate of this work being a somewhat large sum, the proposal was not then carried out. The portion of the wall where the principal movement had taken place was, however, rebuilt in Portland cement mortar, the filling behind was taken out, a dry rubble drain built, and the backing carefully refilled in alternate layers of ashes and dry earth. The backing was not carried to the top of the wall as before, but only to within five feet of the top, the banks of the tanks being sloped. The timber struts, however, were not taken out. The wisdom of this precaution was seen as soon as the tanks were again filled with water, as the wall very soon tightened and squeezed up the timbers, and continued to move nearly a ¼ of an inch per month for more than a year by the giving of the timbers.

In the spring of 1884 it was decided to carry out the recommendation of Mr. E. Filliter, M.I.C.E., which included, beside the invert proposed two years before, the filling up of the space between the retaining wall and the puddle wall of the tanks with Portland cement concrete for a length of 30 to 40 feet opposite each tank; thus forming three large concrete counterforts. The invert is 5 feet 3 inches thick, 2 feet of which is brickwork set in Portland cement, the remainder Portland cement concrete. The invert was constructed the full width of the river in short lengths, the water of the river being carried overhead in a timber trough 12 feet wide and 3 feet deep. Since this work was finished no movement of the wall has been observed.

MARKETS.

(*Per Mr. W. Waddington, Market Superintendent.*)

The market of Burnley is one of the most ancient in the county, dating from 1293–4, when Edward I. granted a charter to Henry de Lacy, Earl of Lincolne, to hold *mercat' feria* at Burnley, and in the "Compoti" of the Earl, rendered at the Manor House, in Ightonhill (an adjoining township), in 1296, the sum of nine shillings and one penny appears for "*making and erecting a Cross in the Market at Burnley.*" The site was near the Old Church, where stood the octagonal base of a market cross of great antiquity, lately removed for street improvements, and placed within a railed enclosure not far distant. In 1520 another cross, called the Foldy's Cross, was erected on ground now enclosed in the churchyard. Ralph Thoresby, the antiquary, when visiting Towneley in 1702, saw this cross, and mentions it in his 'Ducatus Leodiensis' as an instance of markets being "celebrated in the very churchyards." Here they would continue to be held, until the woollen manufacturing, following the course of the Brun, made a new centre, to which the cattle dealers and other traders soon followed and established themselves on both sides of the street, which, as the town increased, became a source of great inconvenience. In the early part of the present century a company was formed who acquired a part of the present market site, and erected upon it shambles and other property for market purposes. In 1865 they acquired an Act empowering them to close the markets in the streets, make a new market, and acquire property. Shortly after, they disposed of their powers and property to the Corporation. The foundation stone of the Market Hall was laid on the 25th of October, 1866, by the Chairman of the Markets Committee, Robert Handsley, Esq., assisted by the Mayor, William Robinson, Esq. To carry out this undertaking, some of the most unsanitary houses in the town were removed, new streets were formed, connecting the centre of the town with the station, and building sites formed for a superior class of shops. The Market Hall was opened on New Year's Day, 1870, by the Mayor, John Barnes, Esq. The following description of it appeared at the time in the local papers: The hall is a parallelogram, 180 feet long, 116 feet wide, and 40 feet high to the apex of the central roof, and is approached by arched entrance gateways on each of its four sides. Shops are provided round the area, thirty-two in number, over which galleries can be fitted up, and made available when required. The entire area is covered by a light, but substantial roof, in three spans, of wrought iron, supported on cast-iron columns with wrought-iron intermediate girders. The whole is effectually lighted from the roof by skylights of strong plate glass, raised on brackets and provided with louvres for ventilation. The basement of hall, owing to the favourable nature of the site—sloping towards the back entrance—has the convenience of a level entrance, and provides commodious premises for shops, stores, and vaults, the whole being arched with brick on iron beams, and made fire-proof. The exterior design of the building, as a whole, does not aim at great ornamentation, being more of a substantial nature, and characteristic of the purpose for which it was intended. The principal front, in the Palladian Italian style, consists of an entrance portico, projecting 12 feet from main building, having a moulded and coved archway, with channelled rustic archstones and keystones, with boldly carved bull's head. The portico is further embellished with four three-quarters attached Roman Doric columns, the shafts broken by square blocks of vermiculated rustic work, and supporting entablature, having frieze with triglyphs, moulded cornice, and pediment, the tympanum of which is enriched with the borough arms, crest and motto—*Pretiumque et Causa Laboris*—supported by cornucopiæ, issuing from them grain, fruit and flowers, the whole beautifully carved in high relief. The side and back elevations show recessed and arched panels, without window openings, to give all available space for shops inside, each recess having a semicircular window above impost of arches, to assist in lighting galleries. A massive moulded cornice with panelled parapet surmounts the whole, from which spring chimney shafts broken by rustic blocks and corbelled cornices. The lofty arched entrance of portico has handsome cast-iron gates, with Italian scroll pattern, suitable to the style of the building, by Macfarlane, of Glasgow. The construction of the building throughout is of the most substantial character, the exterior being entirely of the excellent stone of the district. The roof, strong and effective in all its parts, is also peculiarly light in appearance, and is rendered more so by the judicious and tasteful mode of painting by which it is decorated. The roof has been supplied and fixed by Messrs. Head, Wrightson, and Co., Stockton-on-Tees. The design was selected in competition, and is by Jas. Green, Esq., F.R.I.B.A., of Portsmouth, near Todmorden, and the designs for the interior arrangement, and all other supplementary, detail, and working drawings, and also all specifications, have been made by Messrs. Matthew and Thomas Watson, architects, of Burnley, under whose careful superintendence the whole has been successfully completed. The internal area of the Market Hall is 2,170 square yards, and that of the vaults 1,307 square yards. There is about 30,000 cubic feet of ashlar used in the building, and upwards of 1,000 square yards of glass in the roof.

Also under the Markets Department are the pig markets and the public abattoirs. The site was formerly occupied by the Workhouse of the Burnley Union, and was purchased by the Corporation from the Guardians for the purpose of erecting these abattoirs, extending gas works, and making a new street, much needed for connecting two important districts.

The arrangement of the buildings in the first lot is the same as in the slaughter-houses at Manchester, and the plans were prepared by the then Borough Surveyor in 1878.

The premises are enclosed by a high brick wall. The whole consists of thirteen slaughter-houses, 20 feet by 19 feet, and at the back of each is a lair 16 feet by 16 feet; a large slaughter-house for pigs is also provided. All the houses are fitted with Meiklejohn's patent machinery for hoisting. I am under the impression that the original cost of these buildings was between 6,000*l.* and 7,000*l.*

Some time after these were erected it was found that they were better adapted for private trade, complaints were made of the overcrowding, and it was eventually resolved to extend the premises on a vacant piece of ground within the enclosure. For this purpose the Committee placed the matter in the hands of the present Borough Engineer, who designed and carried out the extensions, which consist of four large slaughter-houses, 29 feet by 27 feet, with lairage 110 feet long by 18 feet wide, and capable of housing forty head of cattle at one time. These houses are fitted with machinery of a very simple kind, made of wrought iron. The ventilation is all that could be desired, and the premises generally are well appreciated. The cost of this addition was about 1,100*l.*

The capabilities of these additional houses and lairage are greater than the whole of the buildings of the first plan;—as many as eighty beasts and from 300 to 400 sheep could be slaughtered in one day, without any inconvenience or overcrowding.

BANK HALL COLLIERIES.

These collieries, which are situated about half-a-mile from the centre of the town, are a great attraction to the members of the Mining Institute and others, as they are considered to be second to none in the kingdom, and if time will only permit, I am sure the Members of this Association will be much pleased with a visit to the same; and I wish here to express my thanks to Mr. Handsley for the kind permission to inspect.

CONCLUSION.

This paper has necessarily been much condensed in order to meet with the very limited time at the disposal of the meeting; but no doubt the inspection of the several works referred to will more fully explain what I have attempted briefly to set forth in print.

I may add that I have much pleasure in welcoming the Members of the Association to Burnley, and trust that the visit will be interesting.

THE VICTORIA HOSPITAL, BURNLEY.

By Mr. J. ARTHUR WADDINGTON.

(For Messrs. W. Waddington and Son, Architects, Burnley.)

The interest in connection with the Victoria Hospital of Burnley is centred in the fact that an important departure has been made from the normal plan of ward blocks in favour of the principle of the circular wards. This principle seems to have been advocated about seven years ago from distinct sources, but it is mainly through a pamphlet published in this country by Professor Marshall, F.R.S., in 1878, that the advantages of the circular form were brought prominently before the professional world. An exhaustive argument on the respective merits of the two forms of ward blocks is impossible upon the present occasion, but it may be briefly stated that the circular ward has been adopted for the following principal reasons. It secures (1) a more perfect aëration of the ward blocks, (2) the freedom from stagnant corners internally, (3) the free admission of sunlight throughout the day, (4) increased floor-space and cubic area with less of lineal wall space, and (5) a central system of heating and ventilation having an equal effect upon all points of the ward. Certain of the above advantages can clearly be demonstrated, others have not been fully confirmed by experience; but in the opinion of a fair number of authorities on hospital construction, they are all within the bounds of a very reasonable expectation. So far as we know, the only circular wards erected or in course of erection are those of the Antwerp Civil Hospital, by M. Baeckelmans, the small Miller Memorial Hospital, Greenwich, by Messrs. Young and Hall, an additional ward block at one of the Union Infirmaries of London, by Mr. Charles Bell, and a small hospital for the Cavalry Barracks at Seaforth, by Sir Andrew Clarke, R.E. The Seaforth Hospital is a one-storey building, and in the other cases the wards are in two or three storeys. The wards of the Burnley Hospital are in one storey, and accommodate 20 beds each, having a diameter of 60 feet and an average height of 15 feet 6 inches. A ward 80 feet by 26 feet, to hold 20 beds, giving 8 feet of wall space, presents a lineal wall surface of 212 feet, superficial floor space 104 feet per bed, and cubic area 1560 feet per bed; whereas a circular ward

60 feet diameter, with 23 feet less of lineal wall space, gives an increase in the floor space of 17 feet 6 inches per bed, and an increase in cubic area of 430 feet per bed. With a perfectly open circular ward the floor space and cubic area would much exceed this calculation, but a novel feature has been added at the Burnley Hospital in the form of a circular staircase, the external walls of which are 16 feet in diameter. This cylinder inserted in the middle of the ward virtually changes it into an annular ward, and displacing a mass of air in the centre, where it is most difficult to renew, may be expected to yield satisfactory results. The spiral staircase, which is easily graded, leads to the roof of the ward, upon which is placed a circular sun room having a diameter of 38 feet, glazed all round. The entire outer circuit is left for a promenade, 10 feet wide, and the leeward side of the sun room will afford effective shelter from the wind when required. The centre of the staircase cylinder is occupied by a circular smoke-flue, immediately outside which is a flue for the extraction of foul air from the ward. These arrangements will be easily understood from the drawings. The wards will be heated by means of three thermhydric stoves supplemented by steam-pipes round the walls. The corridors and certain rooms in the administrative block will also be heated by steam. Steam-coils will also be inserted in the central flue of the ward to assist in the extraction of foul air. Fresh air will be admitted at two heights in the outer wall, and those inlets which are near the floor will be supplied with air-diffusers to break the draught. Warmed fresh air will be introduced through the stoves near the centre of the ward. Tenders have been received for laundry work, cooking, steam heating and hot-water supply, but certain details are still under discussion and no decision has been arrived at as yet. The wards, baths, and lavatories will probably however be supplied from calorifiers conveniently placed in a subway which extends throughout the building, and which will contain all the pipes, facilities being afforded for easy inspection of same. The drains will be entirely disconnected from the building, and will be thoroughly ventilated. The drains from the w.c. soil-pipes will be carried separately to manholes on the confines of the site, where the drains for bath-water, rain-water, &c., will join them. Proper methods for inspection will be provided. The walls of the wards will be lined with glazed bricks of ivory tint pointed with Keen's cement, as affording the most impervious surface. The windows will be glazed with plate glass, and the floors will be laid with oak, polished. At present, in addition to

the administrative block, only two large circular wards, with two separation wards, are in course of erection; but the site affords space for six wards of 20 beds each, a children's ward of 14 beds, and 12 separation wards, giving a total accommodation when complete of 146 beds. The administrative block is designed to serve for the completed hospital.

DISCUSSION.

Mr. **Fowler**: With regard to Scott's system of dealing with sewage;—Are there any published experimental results as to the strength of this cement as compared with Portland cement? Has it ever been tested, with regard to inside work, such as plastering walls? I have an idea that the cement made under Scott's process, when under a warm temperature, gives off damp or salt, in the same way as sea-sand taken from the sea-shore gives off damp from walls when the room gets warm.

Mr. **Stafford**: Before replying to Mr. McCallum with regard to the "Beehive," or to Mr. Fowler about the strength of the cement, I should like the gentlemen if possible to get up a little discussion on the question of wood *versus* granite paving. There is a great difference of opinion as to the merits of these two pavings. Some of you who have laid down wood paving might give us your experience in the matter. But as we have no wood paving here we cannot compare it with granite. As you will perhaps have noticed in my paper, I give three reasons why granite paving is adopted in Burnley:—"1st, because in a town like this with a "very heavy traffic it is more durable; 2nd, from a sanitary point "of view; and 3rd, from the fact that wood paving requires more "attention than granite, hence the latter is much more economical "to maintain, though the first cost is a little greater." I believe granite is more economical than wood, and with regard to the sanitary aspect I have taken of the question I fear that in summer-time, unless the wood paving is thoroughly well cleansed and looked after, the stench arising from it would become very offensive.

The **Chairman**: I have no doubt many gentlemen present would like to accept the challenge thrown out if time permitted. There is one thing I have noticed with reference to the granite paving Mr. Stafford has adopted in Burnley, and that is, he has used the Dalbeattie granite. When granite is used, it is the best plan to take the material which is least slippery, and I do not know any granite which answers the purpose better than that from Dalbeattie. At Warrington I found that several kinds of granite had been put down, but after about twelve or eighteen months' wear, some of it was taken up, and Dalbeattie granite substituted. The cost of wear and tear was reduced, and it was not so slippery as other granite, although it was put down in a part of the town where accidents from horses falling are very frequent. I dare say there are other quarries as good, but in advocating Dalbeattie, I mean that quality of stone, and I think my opinion will be borne out by the practice of all the gentlemen present. I was going to ask this morning whether this cement process at the Sewage Works was still continued, whether it was used really as a commercial operation for the manufacture and supply of cement, or simply as a means of purifying the sewage. We got some particulars on the ground, but perhaps Mr. Stafford will be able to give us some information in a concise form of the strength of the cement, quantity manufactured, and particulars about cost. At Ealing and other places where the lime process is used, the sludge is roughly dried and then thrown away altogether. I should be glad to know if there is any real advantage in adopting Scott's process of cement making in connection with sewage purification.

MR. PLATT: With reference to the question of wood *versus* granite paving, we have no very great length of wood paving in Rochdale, but when the tramway company were making their arrangement with the Corporation there was inserted in the Order a clause that, opposite every place of public worship, the town hall, and other public buildings, wood should be introduced instead of granite. That has been carried out, but I wish it had never been in the Order. We have lengths in different parts of the borough, and when there happens to be a frosty morning we have to put sand on, perhaps twice a day. Wood seems to take so much moisture and it becomes slippery with the least frost, and we have frequent complaints about its dangerous condition. I cannot say much about the sanitary objection, as at Rochdale it has done very well in that respect. I have a report sent me annually from Chicago, and in last year's I notice that wood paving is spoken very strongly against, whilst in England it has generally been understood that wood paving came from America. However, Chicago appears to be up in arms against wood paving, and is substituting granite. I was very much interested with the tool-sharpening machine, and think it must be a great improvement. With regard to Scott's system of dealing with the sewage, I have been anticipated in asking if it is a financial success. I have heard that the cement is not very good, but I understand that is not a matter which affects the Corporation, because they pay a subsidy to the company, who can do as they like. I have been in Burnley once or twice before, and I have always been struck with the small capacity of the tanks at the sewage works, compared with the size and population of the town. In the last volume (79) of the 'Proceedings of the Institute of Civil Engineers' there is an account of what is being done at Frankfort-on-Maine, where an English engineer has built tanks for the purification of sewage with a capacity equal to 25 per cent. of the daily flow of sewage. The capacities in some other towns I notice, are—Leeds 22½, Coventry 30, Aylesbury 26, while at Burnley it is only 16 per cent. These figures, therefore, bear out my opinion that the tank capacity at Burnley is very small. I should like to know from Mr. Stafford, however, if it is considered sufficient, and whether the results have been satisfactory. The effluent to-day was not very satisfactory, and the river water into which it ran seemed to have the best of it every way.

Mr. **Fowler** said he wished to commend an article which appeared recently in the *Manchester Guardian*, on the new Rivers Pollution Bill, to the Members of the Association, which set forth the idea of a standard being fixed for all corporations and public bodies discharging refuse into streams. Certainly the effluent to-day was not anything like what would be required by the standard, and some different process would have to be resorted to to get up to the standard.

Mr. **Platt** observed that it might be interesting to know that the standard of purity proposed by the Rivers Pollution Bill now before Parliament was the standard recommended by the Rivers Pollution Commission. In the 'Health Journal' for last month (April) there was a very interesting article which seemed to have been inspired by the gentleman who drafted the Bill.

Mr. **Meade**: I should like to say a few words about wood paving. I can fully bear out Mr. Stafford's opinion with regard to its durability. In London, especially in the City, there was a large quantity of wood laid some years ago, and in most cases the contractors entered into a maintenance contract for a term of seventeen years. In my opinion the pavement will require to be relaid many times before that term expires. In the West End of London, where there is lighter vehicular traffic, wood paving has been laid. In Regent Street and Kensington there is wood paving, but when it begins to go there seems to be no possibility of successfully patching it, for if new wood is put in, the old wears around it and forms a hollow. If you try wood paving in Burnley, where there are such steep gradients, I think you would soon give it up; unless it is kept constantly gritted, it becomes so slippery that horses are frequently falling.

Mr. **Stafford**: I have a paper here entitled 'Sanitary Objections to Wood Pavement,' and I will read you an extract. The paper quotes a professor of hygiene in France, who says: "I am convinced that a city with a damp climate, paved entirely with wood, would become a city of marsh fevers. Happily all the attempts have failed, and the method has been apparently finally condemned. Wood is therefore reserved for those rough pavements, which, as in Russia and in Wallachia, consist in covering marshy roads with hewn trunks of trees, over which the carriages pass; but this cannot be compared with a regular covering of all the streets with wood paving." The paper then goes on to say: "The account given of it by the Commissioners of Public Works in New York is unfavourable to it on economical grounds; as to the great expense of repairs they state that 'since decay has taken place in the wooden pavement, many complaints have been made of the offensive and unhealthy effluvia emitted from it. This department has used its best endeavours, and all the means at its command, to remedy the evils, but it has only been able to do so to a limited extent.'"

Mr. **Fowler**: I think you are simply losing sight of sanitary reform in allowing the discussion to take this form. For instance, you must not forget that when you lay down wood paving, certain benefits accrue which are not stated in the corporation books. You must remember that dust is allayed, noise is subdued, you reduce the wear and tear of horseflesh, and it also reduces very considerably the wear and tear of vehicles. Corporations are custodians of the ratepayers' welfare, and it is your duty to do the best in a general way, not to look at a subject of this kind in a narrow light, and speak of a horse slipping on a frosty morning. Look at the evidence that was given before a Committee of the House of Commons by one of the print-sellers. He said "We can remove grease, but we cannot remove a spot of London mud." I think corporations should look beyond a mere 1*d.* or 2*d.* in the £. It is the public at large who have to receive the benefit, and you cannot give them the benefit by speeches in the council chamber. In London a petition was presented by shopkeepers for certain streets to be laid with wood, and I think provincial corporations have made a great mistake in not adopting it in busy streets. There is a material saving in horseflesh, and I think wood paving would prove cheapest.

Mr. **Stafford** replied: With regard to the "Beehive" destructor, we have it constantly in use for destroying offal, garbage, diseased meat, street sweepings, market refuse, and occasionally, when required, the ashpit contents of the yard. The "Beehive" will burn, and it is in use 10 hours a day, 15 cwt. per hour on an average. When I say on an average, I mean an average taking combustible with non-combustible matter. It would not destroy 15 cwt. of cabbage-leaves per hour, or rotten fish, but taking street sweepings, cabbage-leaves, and market refuse generally, then it will burn about 15 cwt. per hour. The size is 7 feet in the internal diameter, with a 9-inch brickwork of fire-clay, with two rows of bars. With regard to Scott's cement and a tensile strain, we have tested this cement upon several occasions, and we find that the tests vary from 89 lb. to 250 lb. on the square inch, with one of Bailey's shot machines. The company has not been successful in getting the cement used in Burnley. With regard to the quantity turned out, that all depends upon what orders there are for it. I cannot account for the effluent being bad to-day. As to the tanks being too small, that is a subject that I have not gone into, because, as I said before, the works are not in the hands of the Corporation. The Corporation simply pay a subsidy of 1250*l.* a year to the company, and have nothing to do with the works, the company taking the whole of the sewage. Therefore it is a question which I cannot give you any particulars about, because I have not gone into the matter. But when the works do come into the hands of the Corporation, and if my opinion is asked, I should certainly not recommend the present system. The cement-making process is a very expensive one, but of course, whatever system you adopt to deal with the sewage, you are bound to be at a loss, and the question is how to best minimise that loss. I think the process should be stopped at the burning of the clinker, which is a very good one, and it could be used for the under-bed of the streets to advantage, especially in a district like Burnley where we have a very heavy clay subsoil. Two or three years ago the company did petition the Corporation to add two additional tanks to the existing works, but I do not know why it was not done. Perhaps Mr. Alderman Keighley, Chairman of the Sewage Committee, could give some information on that subject.

Alderman KEIGHLEY (Burnley): I think it was simply a question of cost. We had handed over the works to the company at a given sum, and they took the works off our hands for twelve years; therefore we considered we had completed our contract.

Mr. **Fowler** said he had great pleasure in moving a vote of thanks to the Mayor of the Borough of Burnley for the kindness extended towards the Association during its visit that day. He was sure the Association could not exist one day were it not for the support it received from the chief magistrates of the towns that the Association visited. The profession they represented would not be enabled to have such intercommunication with each other were it not for the hospitality and generosity held out to them. That day they had had honour and pleasure extended towards them in the fullest possible form, and when they found such support as that it encouraged them to do all they could for each other in their various walks of life professionally, and to gather that information which would benefit all of them, especially the corporations they served.

The **Chairman** remarked that the Association was founded as much for the benefit of Corporations as of surveyors themselves. They visited different places with the object of gaining information, but that information was not turned to any value for themselves; they simply used it for the benefit of the different Corporations which they served, and it was his opinion that all Corporations should pay the expenses and the subscription of the local surveyor. He was not mentioning anything new. When he was surveyor to the Corporation of Warrington his subscription was paid, and it was the same in many other towns. It was not a thing which would amount to very much money, but it was a recognition of the Association which he would like to see general. At the Oxford meeting nine or ten surveyors said that their subscription and expenses were paid. It has now become usual for Corporations to subscribe to the Municipal Corporation Association in London, and to pay the town clerks' fees and expenses, and in most towns where Corporations own the gasworks they pay the subscription to the Gas Engineers Association.

The Mayor, in replying to the compliment, expressed, on behalf of the Corporation, a hearty welcome to the Association. He thought the surveyors of the various corporations exercised good sense in forming an association to enable them to meet together from time to time to exchange ideas on various subjects pertaining to their profession. There was not one corporation in the country from which they would not be able to glean a valuable idea of some kind. He might say that as a Corporation they had nearly the whole of the properties that had been visited. With regard to corporations paying the subscriptions of their surveyors to the Association, so far as Burnley was concerned, he could not answer for it, but it would give him great pleasure to lay the matter before the proper authority, and he was inclined to think that the Burnley Corporation would not be niggardly in a matter of that kind. He welcomed the Association with great pleasure, and he might observe that when the proposition was made to the Corporation to entertain the Association there was not a dissentient voice.

Mr. **Lobley** moved a vote of thanks to Mr. Stafford for the paper he had read; to Mr. Williamson, Mr. Leather, and others who had assisted in showing the various works. He remembered when the sewage works were opened, but since that time there had been a very great improvement going on. It was very evident by that, Burnley was improving rapidly and keeping up to the times, and they had had plenty of evidence that day that Mr. Stafford was doing a good work in the town.

Mr. **Stafford** replied on behalf of his brother officials and himself.

Mr. **Knowles** proposed a vote of thanks to Messrs. Waddington & Son, for the exhibition of their plans of the new Victoria Hospital, and for the lucid description that had been read of them. He also wished to include in his motion the officials of the Bank Hall Collieries for their kindness in allowing them to view their works.

Mr. J. A. **Waddington** replied, and the proceedings were brought to a close with a vote of thanks to the Chairman.

Drawings of the several works, in progress and completed, were exhibited around the room and inspected by the Members. These drawings included plans, &c., of the new abattoirs, bridges, municipal buildings, Victoria Hospital, &c.

During the day the Members inspected the following places:—The Store Yard, Yorkshire Street, where Mr. Stafford's patents, the "Beehive" Refuse Destructor and Automatic Sieve were working; also Walton's Patent Tool Sharpener; the New Abattoirs; the River Invert; Gasworks Wall at Strongholme; Daneshouse Canal and Railway Bridges; Scott's Sewage Works, and Bank Hall Collieries. The Members returned to the Council Chamber and discussed the subjects of the papers read. Afterwards the Mayor and Corporation of Burnley entertained the Members to dinner at the Bull Hotel, the Mayor (Ald. Baron) occupying the Chair and Mr. Stafford, the Borough Engineer, the Vice Chair.

DISTRICT MEETING AT NOTTINGHAM.

May 16th, 1885.

Held in the Council Chamber, Nottingham.

Mr. W. G. Laws, *President, in the Chair.*

The Mayor, in opening the proceedings, expressed great pleasure in welcoming the Association to Nottingham; and the President, on behalf of the Association, cordially thanked His Worship for his kind welcome.

Mr. Pritchard was unanimously re-elected Hon. Secretary for the Midland District.

SOME ADVANTAGES AND RESULTS OF THE SUPPLY OF WATER BY METER FOR DOMESTIC CONSUMPTION.

By GEORGE WINSHIP, A.M.I.C.E., Borough Surveyor, Abingdon.

In cases in which local authorities are compelled to carry out works of water supply, on account perhaps of the recent sewering of the district, or other equally important cause, the charges for water for domestic consumption are hard to determine; in many instances a heavy rate must be charged, falling very unevenly upon the various occupiers of property in the district. As the author is of opinion the charges for water for domestic consumption by meter tend to equalise the burden imposed, he desires to lay before the Association some few advantages to be gained by the adoption of the meter system.

Less cost would be incurred in the original outlay from the fact of less water being required, the meter system causing such a considerable reduction in the amount of water consumed.

From the list appended,* extracted from Mr. Latham's work upon 'Sanitary Engineering,' it appears that the flow of sewage from 9 of the 37 towns mentioned is from 50 to 89 gallons per head per day, from 13 towns from 25 to 50 gallons, from 11 towns 15 to 25 gallons, the remaining 4 towns from 4 to 15 gallons, in the latter case it appears there are very few water-closets in the towns. While admitting the above list to show the total volume of sewage delivered, it is certain very few engineers would care to advise an authority to carry out works of water supply unless they could rely upon obtaining 25 gallons per head per day for domestic purposes only.

The cost of meters to consumers must not be taken into account, because the instant the meter is attached to a service-pipe, in connection with any premises, payment at the rate of 10 per cent. commences, and it is not essential that an excessive stock of meters be kept in hand.

The cost of gravitating schemes is stated by Mr. Hawksley to average 9*d.* per 1000 gallons (see extract, Minutes Proc. of Inst. Mec. Eng. London, January 26, 1882). The cost of the Abingdon Works was a fraction under 11*d.* From these facts the author concludes, not that the capital must be doubled unless the supply be by meter, but that it must be considerably increased to enable the engineer to obtain the increased quantity of water required for purely domestic consumption.

The cost of *inspection* by the meter system is so much reduced that some mention must be made of it.

To mention the cases of Great Malvern and Abingdon, in which towns the author has held official appointments, in the former town, previous to the adoption of the meter system, a turntap and inspector combined, held office under the Authority, and he was almost continually employed in detecting waste. Since the adoption of the meter system a tradesman in the town (a plumber) is employed to manipulate the taps only, the trouble and annoyance of repeated inspections of trivial fittings being entirely dispensed with.

So in Abingdon, the turntap employed is able to attend to the flushing arrangements of the sewers, the connecting of all sewers, fixing of meters, &c., and it has not been necessary to inspect or go over any single dwelling for the purpose of examining fittings on the part of the Authority.

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* See appended List A, pp. 158–9.

Another most important advantage of the meter system, to certain authorities, occurs in those districts where the pumping of the sewage has to be resorted to; supposing, as one is entitled to do, in the case of Abingdon, that the whole of the population for which the present supply of water is intended, viz. 10,000 persons, was connected with the main sewers, and that the consumption was at the rate of 15 gallons per head per day, instead of 6 gallons per head, for domestic purposes, which is the quantity in round figures now calculated to be supplied to them, it follows that an extra daily quantity of 90,000 gallons of purely wasted water would flow into the sewers, and which it would be necessary to raise at the sewage farm, entailing an increased and unnecessary cost, to be borne by the inhabitants.

A further advantage would also accrue to all authorities where the sewage was disposed of by irrigation; assuming the calculations before referred to, probably about one-half only of the land generally calculated to receive the sewage would be required.

The land at Abingdon is remarkably adapted for the purpose of sewage disposal, so that no difficulties would be met with if the extra quantity of 90,000 gallons had to be disposed of; but I will not attempt to calculate the extra cost that would be entailed upon some towns if this difference in the quantity of wasted water had to be disposed of by local authorities on unsuitable land.

Another advantage, in the case of the consumer, is, that the amount paid for water, whatever the rate per 1000 gallons may be, is in proportion to the amount consumed; the price per 1000 gallons may be high or it may be low, but it does not affect the relative charge for water consumed.

The appended examples * of rates charged for domestic supplies are extracted from a work by J. Parry, C.E., the peculiar and varied charges being somewhat remarkable, and of course are not based upon the quantity of water consumed. But surely it must be manifestly unfair to charge the same rate to adjoining houses, rated at say 50*l.* a year each, but occupied in one case probably by ten persons and twenty persons in the other. This unfairness will be seen by the following illustrations:—Taking a house rated at 50*l.* a year situated at Lowestoft, the water-rate would be 2*l.* 15*s.* per annum, with an extra for w.c. and bath; assuming one of each in this case, the 2*l.* 15*s.* would be increased to 3*l.* 19*s.* per annum.

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* See appended List B, pp. 160-1.

In Abingdon a house rated at 59*l.* paid in one year 3*l.* 10*s.*, while another, rated at 56*l.* a year, paid but 1*l.* 6*s.* 9*d.* In one case the town water is used solely; and in the other for special purposes only. In the first case the occupiers, including children, number eighteen persons, in the other but ten persons; surely the rate ought not to be equal in the two cases.

The author desires to mention that he looks upon a water supply as being in the hands of the local authorities, and therefore the question of whether the works shall prove remunerative or not upon the capital invested is a secondary matter, the health of the town being the principal object in view. The sum required for management and payment of principal and interest, if not obtained from the income derived from water supplied, is recoverable in the same manner as in the case of sewage works.

Supposing therefore a water rate be charged to those only who are supplied, and take the before-mentioned case, the 50*l.* house in addition to the above rate of 3*l.* 19*s.* per annum would have to contribute its proportion to the district fund according to the deficiency to be made good. Whereas when the supply is by meter, a house supplied by meter has the district rate to pay to make up as before stated any deficiency required, but for water according to the quantity consumed. The author does not go into the question of the kind of meter best suited for the purpose of registering small flows of water, but under present circumstances he has found at Abingdon that Tylor's meter, up to the present time, satisfactorily meets all requirements.

The author has found from experience that consumers of water by meter take care to have better fittings, and they are able to effect this at really less cost than would be the case if no meters were used, because expensive cisterns are not necessary under the meter system, where the supply is constant.

The author anticipates some opposition to this paper, but thinks it should be borne in mind that great objection was made against gas meters when they were first introduced, and remembering as the author does the remarks of several Members of the Association, at the meeting held in Oxford last year, when the subject of meters was under discussion, he trusts that if those Members have not been convinced of the applicability of the meter system during the interim, they must understand the matter is still in its infancy. He can only add, that consumers in Abingdon appear thoroughly satisfied with the meter system as a basis of charge, and in reply to a letter to Mr. Palmer, Town Surveyor of Great Malvern, and Waterworks Manager, he writes, with respect to the "meter system": "The Board and consumers are satisfied with the

A.—Water Supply of a District.—

Name of Town.	Area of District sewered, in acres.	Population of Sewered District.	Average quantity of sewage daily discharged by sewers, in gallons.
Alnwick and Canongate	600	6,000	300,000
Bangor	600	10,500	630,000
Birmingham	8,000	300,000	15,000,000
Bishop Auckland	290	5,000	30,000
Bury St. Edmunds	350	13,000	50,000
Cardiff	344	30,000	2,000,000
Carlisle	2,000	30,000	843,000
Cheltenham	2,000	36,000	600,000
Coventry	—	42,000	750,000
Crewe	—	16,000	613,000
Croydon	1,260	45,000	3,345,000
Haverfordwest	1,760	7,000	150,000
Kelso	100	4,300	60,000
Leek	1,280	10,500	400,000
Leicester	1,300	93,000	3,000,000
Liverpool	7,014	500,000	16,000,000
London	59,010	3,000,000	88,000,000
Loughborough	380	10,800	200,000
Luton	—	17,000	640,000
Merthyr Tydvil	—	50,000	850,000
Nottingham	1,800	120,000	1,900,000
Plymouth	600	75,000	5,000,000
Preston	2,418	83,000	2,000,000
Redhill	—	3,200	286,000
Rugby	200	8,000	382,000
Scarborough	884	23,000	256,000
Selby	2,620	6,000	160,000
Sheerness	150	13,000	310,000
Skipton	130	6,000	116,000
Southampton	800	45,000	2,000,000
Southport	400	12,000	290,000
St. Helens	700	25,000	850,000
Taunton	560	15,000	250,000
Wakefield	1,500	26,000	1,000,000
Warwick	—	10,000	700,000
Waterloo	214	4,500	225,000
Weston-super-Mare	480	10,000	480,000

system, and that it has fully met the purpose for which it was intended, namely the prevention of waste; and further, that the sanitary state of the town is second to none."

TABLE SHOWING THE VOLUME OF SEWAGE OF SOME TOWNS.*

Quantity of sewage discharged per head per day, in gallons.	Proportionate number of Houses supplied with Water-closets.	Remarks.
50	Nearly all.	
50	$\frac{4}{5}$ths.	
50	Very few.	
6	Very few.	
4	1 per cent.	Imperfectly sewered.
66	Nearly all.	
28	$\frac{3}{5}$ths.	
$16\frac{3}{8}$	Nearly all.	
18	420.	
$38\frac{1}{3}$	$1\frac{1}{4}$ per cent.	With exception of about 50 water-closets, all ashpits.
$76\frac{1}{2}$	All	Dry weather flow 56 gallons per head, due to water supply.
$21\frac{1}{2}$	$\frac{1}{2}$.	
14	10 per cent.	
38	1 in 30.	
$32\frac{1}{4}$	6900	6 per cent. privy cesspools.
32	Nearly all	The volume of sewage is the minimum dry weather flow.
29	w.c. general.	
$18\frac{1}{2}$	1 in 80.	
36·4	1 in 30.	
17	But few	Dry weather flow.
16	$\frac{1}{4}$.	
66	Nearly all.	
24	1 in 20	Dry weather flow.
89	50 per cent.	200,000 gallons is spring water.
$47\frac{3}{4}$	$\frac{6}{7}$ths.	Dry weather flow.
11	$\frac{2}{3}$rds.	
26	Nearly all.	
23	1 per cent.	
20	314	Dry weather flow.
44	Nearly all.	
24	About $\frac{1}{2}$.	
34	1 in 30.	
17	90 per cent.	
38	6 per cent.	
70	—	Gelatine manufactory at Warwick uses about 300,000 gallons of water per day.
50	—	
48	$\frac{9}{10}$ths.	

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* 'Sanitary Engineering,' B. Latham, p. 67.

B.—EXAMPLES OF RATES CHARGED

Name of Town or District.	Authority supplying the Water.	Basis of Charges.
Aberdeen	Corporation	Rent Public
Ashton-under-Lyne	Ditto	Rent
Birkenhead	Ditto	Annual Value
Birmingham	Ditto	Rent
Blackburn	Ditto	Rateable Value
Bolton	Ditto	Rent
Ditto, to out Townships		Ditto
Ditto		
Ditto		
Bradford	Ditto	Ditto
Brighton	Ditto	Rateable Value
Bury	Ditto	Rack Rental
Carlisle	Local Board	Rent
Dundee	Commission	
Ditto		
Edinburgh	Trust	Rent
Glasgow	Corporation	Full Annual Value
Ditto		
Ditto, outside Borough	Ditto	
Halifax	Corporation	Rack Rent
Ditto, beyond Borough	50 per cent. extra	
Huddersfield	Corporation	Rateable Value
Hull	Ditto	Rent
Leeds	Ditto	Gross Rent

PER ANNUM FOR DOMESTIC SUPPLIES.

Extra Charges for Single Water-closets, Baths, and High Service.	Annual Charges for Houses of the undermentioned Rents or Rateable Values.																	
	£10.			£20.			£30.			£50.			£80.			£150.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
.. ..	0	2	6	0	5	0	0	7	6	0	12	6	1	0	0	1	17	6
Water Rate ..	0	2	6	0	5	0	0	7	6	0	12	6	1	0	0	1	17	6
W.C. 10*s.* each	0	9	0	1	2	6	1	12	6	2	10	0	3	5	0		—	
.. ..	0	10	8	1	1	0	1	9	4	2	0	0	3	7	4	5	5	0
.. ..	0	10	4	1	18	0	2	9	6	3	0	0	4	16	0	9	0	0
.. ..	0	16	0	1	12	0	2	8	0	4	0	0	6	8	0	12	0	0
.. ..	0	12	8	1	4	0	1	10	0	2	10	0	3	10	0	6	0	0
.. ..	0	13	0	1	6	0	1	16	0	2	16	0	4	8	0	8	5	0
W.C.	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0
Bath	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0
.. ..	0	15	0	1	10	0	2	2	0	3	5	0	4	16	0	7	10	0
W.C.	0	3	0	0	4	0	0	6	0	0	8	0	0	8	0	0	12	0
Bath	0	3	0	0	4	0	0	6	0	0	8	0	0	8	0	0	12	0
.. ..	0	7	6	0	15	0	1	2	6	1	17	6	3	0	0	5	12	6
.. ..	0	15	0	1	10	0	2	2	0	3	5	0	4	9	0	7	10	0
W.C.	0	4	0	0	5	0	0	6	0	0	6	0	0	7	4	0	10	0
Bath	0	4	0	0	5	0	0	6	0	0	6	0	0	7	4	0	10	0
.. ..	0	9	6	0	14	6	0	19	6	1	9	6	2	4	6	3	19	6
W.C.	0	7	0	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0
Bath	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0
.. ..	0	13	4	1	6	8	2	0	0	3	6	8	5	6	8	10	0	0
.. ..	Public Water Rate 1*d.* in the £.																	
.. ..	0	8	4	0	16	8	1	5	0	2	1	8	3	6	8	6	5	0
.. ..	0	6	8	0	13	4	1	0	0	1	13	4	2	13	4	5	0	0
.. ..	Public Water Rate 1*d.* in the £.																	
.. ..	0	9	2	0	18	4	1	7	6	2	5	10	3	13	4	6	17	6
.. ..	0	14	3	1	1	0	1	11	0	2	0	9	3	4	9	6	0	0
W.C.	0	5	0	0	7	6	0	7	6	0	7	6	0	7	6	0	7	6
Bath	0	5	0	0	7	6	0	7	6	0	7	6	0	7	6	0	7	6
.. ..		—			—			—			—			—			—	
.. ..	0	13	0	1	3	0	1	12	0	2	6	0	3	1	0	4	16	0
W.C.	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0
.. ..	0	11	0	1	0	0	1	10	0	2	5	0	3	0	0	3	19	6
Bath	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0
.. ..	0	10	0	1	0	0	1	10	0	2	5	0	3	0	0	6	0	0
W.C.	0	5	4	0	5	4	0	5	4	0	5	4	0	5	4	0	5	4

B.—Examples of Rates Charged

Name of Town or District.	Authority supplying the Water.	Basis of Charge.
Liverpool	Corporation	Rateable Value
Lowestoft	Company	Rent
Manchester	Corporation	Poor Rate Assessment
Ditto		
Ditto, outside city limits	Ditto	Rack rent
Nottingham	Ditto	Ditto
Ditto, outside townships one-fourth more than inside		
Ditto		
Ditto		
Perth in original area	Ditto	
Ditto		
Ditto, outside original limits		
Plymouth in borough	Ditto	Rent
Ditto, outside borough	50 per cent. added	
Preston	Corporation	Rateable Value
Sheffield	Company	Rent
Southport	Ditto	Rack Rent
St. Helens	Corporation	Gross Rent
Tranmere	Birkenhead Corporation	Rateable Value
Wirrall	Company	Rent
Wolverhampton	Corporation	Poor Rate assessment
Ditto, outside Borough		Rental
Ditto		
Worcester	Ditto	Net Rateable value
Ditto, outside City		
York	Company	Rack Rental

per Annum for Domestic Supplies—*continued.*

Extra Charges for Single Water-closets, Baths, and High Service.	Annual Charges for Houses of the undermentioned Rents or Rateable Values.																	
	£10.			£20.			£30.			£50.			£80.			£150.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
.. ..	0	5	0	0	10	0	0	15	0	1	5	0	2	0	0	3	15	0
.. ..	Public Water Rate 6*d.* in the £.																	
.. ..	0	12	0	1	4	0	1	16	0	2	15	0	4	8	0	7	10	0
W.C.	0	10	0	0	10	0	0	10	0	0	12	0	0	12	0	0	12	0
Bath	0	10	0	0	10	0	0	10	0	0	12	0	0	12	0	0	12	0
.. ..	0	7	6	0	15	0	1	2	6	1	17	6	3	0	0	5	12	6
.. ..	Public Water Rate 3*d.* in the £.																	
.. ..	0	10	0	1	0	0	1	10	0	2	10	0	4	0	0	7	10	0
.. ..	0	11	0	1	0	0	1	10	0	2	2	0	2	14	0	4	10	0
.. ..		—			—			—			—			—			—	
W.C.	0	4	0	0	6	0	0	8	0	0	10	0	0	10	0	0	12	0
Bath	0	4	0	0	6	0	0	8	0	0	10	0	0	10	0	0	12	0
.. ..	0	6	8	0	13	4	1	0	0	1	13	4	2	13	4	5	0	0
.. ..	Public Water Rate 1*d.* in the £.																	
.. ..	0	10	0	1	0	0	1	10	0	2	10	0	4	0	0	7	10	0
.. ..	0	8	0	0	14	0	1	0	0	1	8	0	1	16	0	2	0	0
.. ..		—			—			—			—			—			—	
.. ..	0	11	8	1	0	0	1	8	4	2	5	0	3	2	1	3	7	1
.. ..	0	15	0	1	5	0	1	17	6	2	16	3	3	15	0	5	12	6
W.C.	0	6	3	0	6	3	0	7	6	0	9	5	0	9	5	0	12	6
Bath	0	15	0	1	0	0	1	0	0	1	5	0	1	10	0	1	10	0
.. ..	0	11	0	1	2	0	1	13	0	2	15	0	4	8	0	7	10	0
W.C.	0	4	0	0	6	0	0	8	0	0	10	0	0	12	0		—	
Bath	0	4	0	0	6	0	0	8	0	0	10	0	0	12	0		—	
.. ..	0	9	0	0	18	0	1	7	0	2	5	0	3	12	0	6	15	0
.. ..	0	10	0	1	0	0	1	10	0	2	10	0	4	0	0	7	10	0
.. ..	0	14	6	1	8	0	2	2	0	3	8	0	5	8	0	9	0	0
Bath	0	3	6	0	3	6	0	4	6	0	6	6	0	7	6	0	12	0
.. ..	0	13	0	1	5	0	1	18	0	3	2	0	5	0	0	9	8	0
.. ..	0	14	0	1	8	0	2	2	0	3	10	0	5	12	0	10	10	0
.. ..	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0
.. ..	0	4	2	0	8	4	0	12	6	1	0	10	1	13	4	3	2	6
.. ..	0	10	0	1	0	0	1	10	0	2	10	0	4	0	0	7	10	0
.. ..	0	10	0	1	0	0	1	10	0	2	4	0	2	16	0	4	10	0
W.C.	0	5	0	0	7	0	0	10	0	0	10	0	0	10	0	0	10	0
Bath	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0	0	10	0

DISCUSSION.

Mr. E. **Pritchard**: I have no intention of expressing any opinion, further than that I expressed on the reading of a paper at Oxford some time since, which seems to have anticipated to a great extent that now read. The author of this paper refers to the small consumption of water at Abingdon, representing some 6 gallons per head of the population. This, in my opinion, Sir, appears to be a forced restriction rendered necessary by a scheme of water supply, which, on the face of it, does not appear sufficient for the requirements of the population. I do not know whether that is the case with respect to Abingdon, but I think, in many towns in the country, meters are used for the purpose of restricting the supply of water. If the scheme for obtaining water is expensive, or the supply proves deficient, it is a very natural result that the consumption should be curtailed, and no doubt by using meters that result would be attained. But my opinion now is very much the same as that which I expressed on this subject at our Annual Meeting at Oxford. There are gentlemen present who will tell you they have found it necessary, in the interests of sanitation, to remove meters. It has been put forward that the meter system is the means of preventing waste. No doubt this is so, but I would venture to suggest we can very well prevent waste of water without the use of meters being universally adopted. I have a report from a Member of this Association in reference to the supply of water to a town in the Midlands; and I find that, with an intermittent supply, the consumption was something like 44 gallons per head; and now, with a constant supply, he has reduced that consumption to 13·4 gallons per head. This has been done to some extent by means of meters for manufactories, and house-to-house inspection. I think it is very undesirable to restrict the supply of water to households, on various sanitary grounds. I do not know that I have anything further to add, except that the details the author of this paper has given us will undoubtedly be very useful for reference. I see my copy of the paper is marked "unrevised proof." I find many of the figures given in Schedule A are taken from Mr. Baldwin Latham's 'Sanitary Engineering,' which probably at the time that work was issued were more accurate than they are at the present time. I think it would be desirable to have these figures revised, and probably the author of this paper would kindly undertake to do so. I can name one or two cases, where, from my own knowledge, the figures given must be wrong. I find the Nottingham sewerage district area is given as 1800 acres, but I believe at present it is something like 9000 acres. Again the daily quantity of sewage is represented as 1,900,000 gallons on the average; but I gleaned from some remarks of Mr. Tarbotton, there is now something like 8,000,000 gallons instead of only 2,000,000. The figures relating to Birmingham, Coventry and Warwick, are not accurate. I do not suggest that this is in any way the fault of the author of this paper; but I think it would be desirable, before this paper is incorporated in our 'Proceedings,' that these figures should be revised.

Mr. Gordon: I think it should not be taken that the conclusions which the author of this paper has put forward are endorsed by the Association. Mr. Pritchard has covered some of the ground I had intended making a few remarks upon; but I should like to say this much, that I think the principle of restricting the supply of water for domestic purposes, by anything in the shape of measuring the quantity consumed, is altogether wrong. I believe it is a retrograde step to advocate meters being used to measure water consumed for domestic purposes. Mr. Pritchard has told us that the consumption can be largely reduced by the adoption of the ordinary means of checking waste. After the proof of Mr. Winship's paper reached me, I asked the engineer and manager of the Leicester Waterworks how we stood, as we are considered to be approaching the limit of supply, and it is of the utmost importance that waste of water should be restricted. I find that the consumption for all purposes in Leicester has been brought down from 26 gallons per head in 1879 to 18·76 gallons per head. Seven and a half gallons per head of that is supplied for manufacturing purposes, measured by meters, and therefore the consumption for domestic purposes is 11·26 gallons per head. This has been done without introducing the very ingenious method of detecting waste introduced into Liverpool by Mr. Deacon, and it would seem to be possible to reduce it still further by that means. But, if you introduce water-meters, it is quite clear, as the author of this paper has stated, that consumers of water will constantly have before them—as they have in the case of gas—methods of reducing the consumption, so as to cut down the water bills.

They have thus inducements to lessen the consumption of water instead of that free use of it which, combined with the introduction of baths, and in other ways, conduces to an improved sanitary condition of the people. Therefore, on these grounds, I should never favour the introduction of meters to measure the water supplied for household purposes. The author of the paper thinks that, by the introduction of water-meters—and he is no doubt right—you will reduce the water consumed for general purposes to such an extent, that there will be a great saving in the cost of the water supply, that might lead to the quantity of water per head for the supply of a new district being fixed at a lower figure than is supposed to be necessary at the present time. But if you follow this further, you will find that you are imposing the penalty of an increased charge for the water, notwithstanding the saving on the whole supply, on the lower classes of the people, who ought really to be induced to use water freely in every possible and legitimate manner for sanitary purposes. To give an illustration, if a man lives in a house rated at 50*l.* per annum and has only six in family, and another person in a house rated at 25*l.* with a family of twelve persons, the ratal system of charge was manifestly unjust to the person occupying the 50*l.* house with a family of only six individuals. That may be so apparently, but if you introduce water-meters, then the cost of the whole supply has to be covered by a fixed charge per 1000 gallons. You must, therefore, necessarily increase the charges to those who consume water. These charges would then fall and press more heavily on the tenant of the 25*l.* house with twelve occupants, than on the occupier of the 50*l.* house with six inhabitants, and would lead in the case of the former to a restriction of the use of water, which beyond absolute waste is neither in the interests of the individual nor the community at large. There may be injustice in basing the charge for water on the rateable value of property, but the meter system would entail a still greater injustice, because the occupier of the 50*l.* house would be better able to bear the charge than the person who occupies the 25*l.* house. We are certainly indebted to the author of the paper for giving us an opportunity of expressing our views on this subject; he may be perfectly right in introducing water-meters as he has done at Abingdon and Malvern, and there may be exceptional circumstances not put before us, to justify their introduction in those cases. Mr. Pritchard has hinted that perhaps the water supply at Abingdon is so restricted that they could not supply the inhabitants with that quantity of water which would be freely used in other towns. The author has not told us to what extent baths are used at Abingdon. That would be useful information, and also the number of water-closets. At Leicester the 11¼ gallons per head includes 1154 baths and 15,000 water-closets. If the water used for so large a number of closets and baths were deducted, it is clear that the Leicester consumption would be greatly reduced—but would the sanitary condition of the people be improved? Certainly not. I think it is desirable to have these things, which we all admit to be great improvements upon the arrangements of the past generations.

Mr. A. M. **Fowler**: I think Members of this Association are to a great extent custodians of public health, and should be the last to sanction any water-meter system. For instance, we know from history, after the great plagues of London threatened to exterminate the whole of the inhabitants, when the city was on the ash-pit and cesspool system, a Bill was passed in 1847—I do not know what the name of the Corporation was then—that the water-closet system should be introduced throughout the metropolis. It was almost like magic that the order was carried out; and London to-day, and for years past, I think we may say, is the healthiest city in the world. To-day we have seen the tub system admirably carried out; and I admit it is the most complete system I have seen in its manipulation. We have it in Manchester, and in many Lancashire towns. This Association has very properly expressed its opinion of the system. But why have we in these towns this pestiferous stinking system; this inhuman means of cleansing the tubs and the charging of them from time to time. Why should human beings be put to such filthy labour? Is it right that, in a Christian land, we should put our fellow-men to such work as that in which we have to-day seen 200 or 300 men engaged? I say not. It all arises from this false economy, this restriction upon the use of water. We are all agreed that there should not be any waste of water; but you must not restrict the supply. The working-men of this country are, so to speak, without baths. I say every man who does what is just and right, should have all the advantages and benefits water can confer, the same as the greatest lord or lady of the land. Therefore, I hold that every working-man should have, if possible, a bath in his own house. The human race is so framed by the Almighty that, if we do not take care of each member, we have to pay the penalty. If we do not take care of our brother, the seeds of contagion will lay hold of him, and if you go on restricting the water supply in this way, it is simply taking a narrow-minded view of our mode of living. I cannot understand that, in this advanced age of sanitary science, any man should come forward and advocate a meter system of water supply for domestic purposes. Some time ago, in the earlier days of this Association, I read a paper on the utilisation of towns water. I then said it was a shame to waste fresh spring-water in watering streets where there was not an abundant supply. We know that many towns—Manchester for instance—are limited in their water supply. The Rigby Paper Company, after a precipitation process, and then a filtering process, are sending the water away purer than any of the Thames water supplied to the inhabitants of London; if we could utilise the water from our sewers in this way, it might be used for watering the streets, and indeed for every purpose except cooking, drinking, and washing. But I would never attempt to curtail the bright water supply of our towns, or even purified water from our sewers, by any restriction in the shape of meters. The distribution of water only costs something like ½*d.* per 1000 gallons, and to bring it to a town about another 2*d.*, so that, at the present price of materials, you can afford to sell it at 5*d.* or 6*d.* per 1000 gallons to small consumers. Therefore I say it would be a great calamity to this country if, for the sake of 5*d.* or 6*d.* per 1000 gallons, we should restrict the working-man from having an abundant supply of good water. I therefore endorse the remarks of previous speakers, that it would be almost a crime to introduce the meter system into large towns.

Mr. COMBER: I should like to say a few words, as one who has had some experience of the meter system, in two towns, for several years. The ground has been gone over pretty well by Mr. Pritchard, Mr. Gordon, and Mr. Fowler. If you compel the use of meters, in larger houses it may not so much matter, but if you compel owners of small blocks of cottages to put in meters to supply the poor people who occupy them, the landlord will naturally resort to every possible means to restrict the supply. I contend you do not want meters if you have a proper system of inspecting water-fittings. Some years ago we had a warm discussion in our Council about doing away with meters for domestic consumption, and it was decided that they should be removed wherever the water was supplied solely for domestic purposes.

That was done, and a proper and systematic inspection of water-fittings was instituted, and at the present time we are not using nearly so much water as when the meter system was in existence. Mr. Winship has also raised the question of the saving that would be effected in pumping the sewage. We have to pump our sewage to a height of 120 feet, and we have not found, since water-meters have been done away with, that it costs any more to pump the sewage. Meters are very expensive, cost a lot for repairs, and there is a great deal of trouble with them in winter; and therefore I consider the meter system costly. We should, as sanitary engineers, encourage and not restrict the legitimate use of water.

Mr. **Winship**: It appears to me that my paper has not found many advocates, but I am sure you will understand me when I say my sole object was to ventilate this matter. I did not endeavour to make a particularly long paper, but just one which would raise a discussion, and so far it has attained the object I desired. With regard to the statistics referred to by Mr. Pritchard, I have stated where I got them from, and therefore I cannot be responsible for their accuracy, but I shall be very happy to have them corrected. Mr. Pritchard did not say anything on the fairness of the charge, and it seems to me the whole point is misunderstood. I have had a great deal of experience in connection with waterworks for the past twenty years. I was with the Kent Waterworks, and while there I had the district of Rotherithe to inspect specially, previous to the constant supply being laid on. Waste cannot always be found out by inspection only, but any one who has had any practice in connection with waterworks will know that, with the meter system, an inspector on going round will readily detect waste. In my own town a leakage of 600,000 gallons was discovered, which, even with careful inspection, would not have been discovered, because it was from a defective pipe under the ground. By meters you find out defects which would not otherwise be detected. Then, with regard to the expense of putting on the meters, either to the Corporation or the owners, and to the use of meters generally, I may say that the meter system has been considered so important that it was discussed at a meeting of the Institute of Mechanical Engineers. I have a copy of the paper, and I find there with regard to the question of cost, that under the meter system, fittings and everything included, an occupier can get a water supply at a cheaper rate than under the other system. There is one example given there.

A person says he applied to the water company to put on a meter and be supplied by measure, but they would not allow him to do so. He was told that if he had a water-engine, he could compel the company to supply by meter, and at last, after some difficulty, he prevailed upon the company to do so. The result was a decrease of one-half of the cost of what he had previously paid. As an evidence of the interest taken in the subject, I may say that, since we have had the meter system in operation at Abingdon, visitors have come to me for information from America and from France, and I have had numerous communications from authorities in England asking for particulars. This tends to prove that the quantity of water wasted is a serious and important question. At Abingdon, if we consumed anything like 20 gallons per head, it is doubtful if we should have sufficient. Where there is a siphon such as we have, there is a danger that we might find ourselves unable to supply the town for some considerable time. Ours might be a special case, but the meter system is considered a very great advantage.

Mr. F. BAKER: I am of opinion that the meter system could not be adopted in large towns already supplied, as an enormous outlay would have to be expended on meters alone, besides the additional expense of inspection, maintenance, and renewals, not to say anything of the sanitary aspect of the question—that the restricted use of water would very materially affect the health of the poorer classes and would considerably increase the death rate. I believe it is the general opinion of all engineers experienced in this subject, that the most economical and only way to check undue consumption and prevent waste, is by careful attention to the carrying out of the rules and regulations, and a periodical system of inspection of house services and fittings. There can be no doubt that the principal cause of excessive waste is defective fittings and bad workmanship by unskilled labour, which is more frequently met with in small towns, and these can only be checked by rigidly enforcing the rules and regulations as embodied in the Public Health Act 1875, and a periodical system of inspection. As to the cost of such inspection, in Sheffield, with a population of 300,000, there are three inspectors, and the consumption is as low as 16½ gallons per head of population for all purposes. Some three years ago at Loughborough the consumption was over 30 gallons per head for all purposes, but by inaugurating a constant system of inspection, assisted by new rules and regulations, we managed to reduce it in a few weeks to less than 20 gallons per head, with the ordinary staff and very little additional expense to the Local Authority. I need not take up your time by entering into the sanitary aspect of the question, but only urge in conclusion that I think it is the duty of local authorities, especially those having control of the water supply, rather to take steps to induce the working classes to use more water, and to be more cleanly in their habits; as, for instance, the establishment of public baths and laundries, which would help to reduce the death rate still lower, and would be far cheaper to the town in the end than the introduction of water meters for domestic supply.

The President: I should like to ask you to give a vote of thanks to Mr. Winship for the interesting paper he has read; but before formally doing so, I will just say one or two words on the subject of water-meters. I think there appears to be a concensus of opinion on the part of the Association, that, however desirable it is to restrict waste, it is very undesirable indeed to restrict consumption. With that opinion I most cordially agree. I think we had far better run the risk of a certain amount of waste than in any way restrict the use of water for domestic purposes. The figures which have been mentioned, as giving the consumption of water in certain towns, rather astonish me. At Newcastle-on-Tyne we are using a trifle under 40 gallons per head, and I do not think we use at all too much. The amount that is used for what I may call public sanitary purposes has been mentioned once or twice. I have taken some trouble to ascertain what it is in Newcastle; and for watering streets and flushing sewers, the amount used does not exceed 1½ per cent. upon the entire consumption. I notice that in England, even where we consider the supply to some of our towns large, it is small compared to what they have in some other countries. In America, for instance, I find that the consumption in some of the principal towns ranges from 60 to 96 gallons per head. I venture to say this is a very desirable state of affairs, and that such an abundant supply of water will tend to a good sanitary condition of a town. I will not say anything more, gentlemen, but will simply ask you to pass a vote of thanks to Mr. Winship for his paper.

FIVE YEARS' MUNICIPAL WORK IN NOTTINGHAM.

By ARTHUR BROWN, Assoc. M. Inst. C.E.,
Borough Engineer, Nottingham.

The following description of the works carried out in this borough during the last five years is not intended to be a full and complete history of the whole of the undertakings of the Corporation in that period; it is sought rather to describe a few of the more important undertakings and to generally summarise the work which is directly connected with the office of the borough engineer, and to show what responsibility and labour this work involves in rapidly-increasing boroughs, giving at the same time such general particulars as may be necessary.

There are six distinct divisions into which the subject may be divided. (I.) Contains particulars of population, with special reference to the rate of increase. (II.) Number of new buildings erected. (III.) Roads and streets, including private street improvement works. (IV.) Storm-water culvert and general sewage works. (V.) Public street improvements. (VI.) A description of the pail closet system.

Before proceeding, however, with the subject, it would perhaps be found interesting to give a short description of the general features of the town in which the Members of the Association are now assembled.

On the southern side of the town flows the river Trent, which forms the boundary of the borough for almost the whole distance where it abuts upon the town; from the Trent, for a distance of about a mile northwards, originally was meadow land below flood level, the whole of which has had to be raised about 6 feet before the permanent building level could be reached.

The hills, which may be called the backbone of the town, commence at the Castle, and after bearing north for a short distance, extend along the forest side in an easterly and north-easterly direction up to Mapperley Plains; the rise from the ordinary finished level of the streets in the meadows to the highest point in the borough, is about 343 feet. The gradients leading from the market-place northwards and north-west, are necessarily very severe, and in one case (that of the Derby Road) the gradient is as steep as 1 in 13. The extreme length of the borough is about 6¾ miles, the extreme width about 4¼ miles, and the area 9960 acres.

The town is fairly well supplied with recreation grounds which are so necessary in all large towns; of these the largest are Bulwell Forest, recently acquired by the Corporation, having an area of 135 acres; and the Nottingham Forest, which is about 80 acres in extent; the total area of the recreation grounds is about 280 acres. All these recreation grounds, except Bulwell Forest, are situated in the old part of the borough as it existed before the extension of the boundaries, and were provided under the powers of the Inclosure Act of 1845, and it was a most wise step on the part of the Commissioners to furnish a number of such open spaces, which act as the "lungs" of the town, and which are so necessary to the inhabitants.

(I.) Population.

The population of the town, estimated by the Registrar General to the middle of the present year, is 211,424.

The population in	1841	was	53,091
,,	1851	,,	57,407
,,	1861	,,	74,693
,,	1871	,,	86,621
,,	1881	,,	186,579

The number of houses in	1841	was	10,934
,,	1851	,,	11,549
,,	1861	,,	15,441
,,	1871	,,	17,911
,,	1881	,,	38,548

It is computed that since the census of 1881 there have been built in the borough about 11,000 houses: taking the number of houses in 1881 at 38,548, and the population at 186,579, there would be 4·8 people to a house on an average; even allowing that there are 2500 empty houses in the borough (and this is possibly an excessive estimate), there would be a nett total of 8500 houses built and occupied; this multiplied by 4·8 gives an increase of population of 40,800; add this to the population at the census in 1881 of 186,579, and the result is 227,379, which is considerably in excess of that estimated by the Registrar General, which, as previously stated, is 211,424. There is no doubt therefore that the population has increased more rapidly than estimated by him, and that it may safely be estimated at about 227,000.

It will be noted that there is a very considerable increase of population between the years 1871 and 1881, between which dates the population was more than doubled; this was caused very considerably by the fact of the extension of the borough having taken place in the year 1877. The estimated population of the districts then added to the borough was about 57,000; the area of the old borough was 2000 acres, and the area of the districts added was 7960 acres. There is no doubt that the extension of the boundaries has been of very great benefit to the town, as improvements in drainage and main thoroughfares and other matters have been carried out, which could not have been brought to a successful issue when there were a number of divided authorities to be consulted.

As regards the density of population, assuming the population at say 227,000, and the area at 9960 acres, the result is 22·7 persons to the acre. But these kind of statistics are to a great extent very misleading, as they give no real idea of the density of the population in towns. In the Registrar General's Annual Summary for 1882, is a table giving number of persons to an acre in twenty large towns, and the number ranges from 11·9 in Norwich to 107·6 in Liverpool; Nottingham is given as 19·4, this being based upon the population being 193,573 in 1882, whereas the density now is 22·7 to the acre. Some portions of the town, however, are very closely built over, and according to particulars obtained by Dr. Seaton, the late Medical Officer of Health for this borough, some districts of the town are so closely built over, that there are upwards of 300 persons to the acre. As he says in his report, it is in these districts "that the resources of the local authority are strained to the utmost, and that the only way of dealing with them is by some comprehensive scheme, under an Act of Parliament, so that such areas may be cleared and rebuilt with a due regard to sanitary requirements, so that the population may be more spread out, and the health of the town thus improved."

(II.) New Buildings.

Attention has been called to the very rapid increase in the population in this town, and there naturally follows the question of how this increase has been provided with house accommodation. It is estimated that during the five years ending 31st March, 1885, there were built in this town about 13,500 houses: the greatest number of houses that were built in one year was in 1883, when 3302 houses were erected. In that year returns were obtained from twenty of the largest towns, and it was found by comparison that, having due consideration to its population, the building operations in this town were quite unprecedented. The number built in the borough in that year nearly equalled the number erected in Liverpool, Birmingham, Glasgow, and Leeds collectively; these four towns represented a population of 1,839,000, whereas Nottingham then had a population of 205,000 only.

It was found that, during the time for which any statistics could be obtained, there were only three towns which compared with this town as regards building operations, viz. Birmingham, which in 1875 built 3395 houses; Glasgow, which in 1875 built 6645; and Liverpool, which in 1845 built 3728. Comparing the building operations in this town in 1883 with three others, *in proportion to population*, there were built in Nottingham 20 houses to 1 in Glasgow, or 8 in Nottingham to 1 in Birmingham, or 10 in Nottingham to 1 in Leicester. It has been estimated that there have been built in this town 13,500 houses in five years. If these were taken at the low average cost of 150*l.* per house, the result would be upwards of 2,000,000*l.* as the amount spent on house building operations in five years.

Although there are no very stringent building regulations in the borough, it is believed that the houses generally are fairly well built, and the requirements as regards drainage, disconnection of drains, ventilation of soil pipes, &c., have been well looked after. It is satisfactory to be able to say that the "jerry builder" has not been so busy in this town as he is reported to have been in some towns; one reason may be that the fact of every house having to be certified by the surveyor before it can be inhabited exercises a very wholesome effect on the speculating builder.

(III.) ROADS AND STREETS.

The length of roads and streets is as follows:—

	Miles.
PUBLIC HIGHWAYS—	
Paved with granite	50
Macadamised	45
Paved with wood	1¼
Total	96¼
UNADOPTED PRIVATE STEETS—	
Paved with granite	29
Macadamised	21
Total	50

The whole length of roads and streets in the borough is therefore, say, 146 miles. It will be noticed that the length of unadopted private streets paved with granite is 29 miles: this appears a large amount, but the greater number of these streets, however, are in a transition state, and will be taken over as public highways as soon as they are entirely completed.

After the subject of building operations there naturally follows the question of sewering, paving, and completing of private streets. In consequence of the rapid extension of the town, this work has been one of unusual extent. The compelling of owners to sewer and pave private streets is done, as you are aware, under the 150th section of the Public Health Act, 1875; in some towns it is the practice for the private owners, or the persons who lay out an estate, to sewer, pave, and complete the private streets on same, and then hand them over to the local authority. In one large town, having upwards of half a million inhabitants, the section referred to in the Public Health Act has never yet been put in force. In one of the most important neighbouring towns the amount expended in private improvement works in 1883 was under 1000*l.* In this borough it is the exception for the works to be done by the owners themselves; the greater portion is done by the Corporation, and in the year 1884 this work amounted to about 60,000*l.* This nearly equals the total value of similar work done in six of the largest towns, having a population collectively of about 2,000,000 inhabitants.

It has been previously stated that in some towns the work is done entirely or nearly so by the owners themselves; the method adopted here has its advantages, inasmuch as the work is done almost wholly by the Corporation staff, and is therefore done on one system, and is done better than it would be by the private owners. The fault the author personally finds with the system is that it casts an enormous strain and responsibility on the borough engineer and his staff, in order to carry out the works at a speed to keep pace with the rapid extensions.

The work of sewering should be completed in advance of building operations, and the kerbing, channelling, and paving follow as soon as the sewer trench may be settled. It is necessary that the paving should be carried out as soon as houses are built, as sloppy and dirty streets have a prejudicial effect upon the health of the inhabitants, apart from any question of comfort.

In private streets the causeways are kerbed with a kerb 12 inches by 6 inches or 12 inches by 8 inches; the channel is composed of two courses of 5 inch by 4 inch granite setts, and the carriage-way is paved with granite "randoms"; the causeways are either laid with 2½ inch York flagging or with blue bricks.

The amount of money spent on private improvement work during the last five years is about 210,000*l.*, and has entailed the execution of:—

22,333	yards or	13	miles of	sewering.
79,805	„	45⅓	miles of	curbing.
337,821	„	70	acres of	new granite paving.
9,682	„	2	acres of	old paving repaved.
85,941	„	17¾	„	flagging.
46.729	„	5	„	blue brick paving.
23,281	„	5	„	asphalte footpath.

The work of preparation of plans and sections, the serving of notices, the making out of accounts and appointments, and the superintending of these works, necessarily involves a very considerable amount of labour.

Next with regard to the public thoroughfares in the borough: the paving usually adopted for the main streets is 3 inch by 5 inch or 3 inch by 6 inch granite "setts," on a foundation of concrete about 8 inches thick, and having joints run in with a composition of pitch and tar; the subsidiary streets are paved with stones known as "granite randoms."

There are about 15,000 square yards of wood paving in the town, of which 13,000 square yards have been laid during the past five years; both creosoted and uncreosoted red deal, and also creosoted beech blocks have been tried. The whole of the work has been done by the Corporation staff, at prices, it is believed, considerably below what is charged by the various companies who contract for such work. The last piece of wood paving executed was in St. Peter's Gate, and was laid with beech blocks 3 inches by 6 inches, on a foundation of Portland cement concrete; the concrete was floated to a perfectly smooth surface to the exact contour of the road and the blocks laid directly on to the concrete when set; the spaces between the rows of blocks were kept by ⅜-inch creosoted fir laths. The joints were nearly filled in to the top with dried ironstone cinder chippings, and then run in with the usual composition of pitch and tar. A large portion of the work in this street has been laid on the site of an old churchyard, which had been excavated to a depth of 9 feet in order to remove the coffins, bones, &c., before the land was thrown into the street; on this portion, and also where trenches have been dug for laying of new gas and water mains and services, from 12 inches to 18 inches in depth of concrete was laid. Beech blocks are believed to be the best material for wood paving: the author's experience is that there is nothing to equal them for wear; one thing only at present prohibits their being used so extensively as they ought to be, and that is the cost. The cost of wood paving with ordinary creosoted red wood blocks and including 8-inch concrete, is 11*s.* 7*d.* per yard. This price includes taking up old stones, excavating and preparing ground, and carting away old material and stones, and everything complete. The cost of the wood being from 6*s.* to 6*s.* 4*d.* per yard super, including laths; the cost of the wood only for the beech block paving is about 9*s.* per yard super. Creosoted beech block paving, therefore, costs from 2*s.* 8*d.* to 3*s.* per yard superficial more than creosoted red deal paving.

A *sine quâ non* for wood paving is a thoroughly good concrete foundation. The author has heard that in some towns, wood paving has been extensively laid on the natural ground without any concrete foundation: he would expect to hear that this paving would be in a ruinous condition after a few years wear, unless the traffic is *nil.*

Footpaths and Asphalte Macadam Roads.

This town is generally understood to be the place of origin of asphalte footpaths and asphalte macadam roadways, and that being the case, the author may be forgiven for taking up a portion of the time by referring to this method of laying footpaths and carriageways. The first piece of asphalte footpath was laid on the London Road in this borough by Mr. Thomas Smart, in the year 1840. It was done in a very primitive fashion, and was composed entirely of tarred round gravel covered off with sand. About that period a number of asphalte macadam roadways were laid in the town, which were laid in a similar manner, but with broken boulders instead of round gravel. The method of doing this work has been greatly improved, and it is now uniformly done on this principle: a bed of tarred round gravel or ironstone slag, 1¾ inch or 2 inches thick, is laid for a bottom coat, and the upper coat, from 1 inch to 1¼ inch thick, of fine ironstone slag, limestone, or granite screenings; these materials are well dried on a floor of heated iron plates, and mixed with a composition of pitch, tar, and creosote oil, each layer is well rolled, and the top coat is sprinkled with spar. It is of the utmost importance that the slag, &c., should be perfectly dry, and that the pitch, tar, and oil should be of the best quality. The cost of this kind of pavement is 1*s.* 4½*d.* per yard super. The quantity of asphalte footpaths laid on public roads during the last five years is about 100,679 square yards, or 20 acres.

The next kind of pavement for footpaths which is worthy of notice is cement concrete. This is laid on a foundation of hard broken bricks, about 2 inches or 3 inches thick: the concrete itself is altogether 3 inches thick; the lower, 2 inches thick, is composed of river gravel, or ballast and cement in the proportion of 8 to 1, and the upper coat, about 1 inch thick, is laid on before the other is quite set, and is composed of fine granite chippings and cement in the proportion of 1½ to 1. The cost of this pavement is about 3*s.* 8*d.* per yard super, which includes preparing ground, carting away old material of footpath, and everything complete.

In some cases the concrete has been laid 2½ inches thick in the proportion of 1½ of granite to 1 of cement. The granite must always be well washed, and the cement used should be of a quality to stand 900 lb. and upwards on a briquette having 2¼ inches area.

Cement concrete makes an impervious and bright looking footpath, which compares favourably with blue brick paving. The author believes that cement concrete footpaths will come into extensive use, and hopes they will entirely supersede the dull-looking blue brick pavement.

There are a number of asphalte macadam roads in the borough, but time will not allow of full details being given of this work, but a general description of this kind of carriageway will be given under the heading of Street Improvements.

There are about 185,000 square yards of asphalte macadam carriageways in the borough, of which about 130,000 yards have been laid down during the past five years.

On the maintaining, repairing, &c., of the streets and sewers, watering and scavenging, and on other works (excepting private improvement works) executed by the Works and Highways Committee of the Corporation, the sum of about 34,000*l.* is now spent annually. To carry out their work efficiently the Committee have at their disposal the following plant:—

2 Fifteen-ton steam-rollers.
2 Cranes
1 Sand-distributor.
4 Snow-ploughs.
13 Four-wheeled water-vans.
24 Two-wheeled water-carts.
24 Two-wheeled stone-carts.
24 Two-wheeled scavenging-carts.
1 Four-wheel scavenging-cart.
14 Machine-brushes.
4 Machine-scrapers.
4 Tar-boilers.
2 Tar-barrels.

The principal depot of the Works and Ways Committee is situated at the Eastcroft, and comprises offices and houses for the road surveyor and three men, stables for thirty-five horses, cart-sheds, store-houses, asphalte-mixing shed, stone-breaker and horizontal engine for driving same, and steam-hoist. There is also an extensive granary and hay stores over stables. The whole of these buildings have been erected during the last three years. In consequence of the rapid increase in this Committee's work, it is intended at once to extend these stables so as to provide additional accommodation for eighteen horses, with room over, which can be used as mess-room for men employed on the works.

The number of men now employed is about 537, the number of horses employed altogether being 108, forty-five horses belonging to the Committee, and sixty-three being hired. In times of great pressure of work there have been employed 710 men, 130 horses and carts, and the wage sheet has amounted to 912*l.* per week.

(IV.) STORM-WATER CULVERT AND SEWERAGE WORKS GENERALLY.

One district of this town, known as the Beck Valley district, has been subject to very severe floods in summer times, caused by the heavy downpours of rain during thunder-storms. During the summer of 1880 and following years a number of storms occurred and the main streets were flooded in places to the extent of 2 feet, the cellars in the lower parts of the district, and also the living-rooms in many cases, were filled with a mixture of storm-water and sewage which rendered the houses for a time almost unfit for habitation. The heaviest rainfall on record occurred on the 22nd of June, 1880, which was 1·4 inch in 30 minutes; in this case houses were undermined by the water, two houses were totally destroyed, and a very considerable amount of damage was done to the trade stock of a large number of people who were in the habit of storing their goods in basements.

The matter was referred to a special committee, who instructed the author to report on the whole question. The subject required very careful consideration. The gradient of the road in the valley was about 1 in 100, but the streets on either side of the same were exceedingly steep and almost precipitous, as in some cases the gradients were as heavy as 1 in 6. The rise from the lower part of the valley, where the flooding was worst, to the top of the hill forming the boundary of the watershed, was 314 feet. In times of storm, therefore, the rain-water was precipitated with most tremendous velocity and force into the valley, where it formed a stream in some places the whole width of the main road, and from 12 inches to 18 inches deep; this flowed down into the lower parts of the town, where it reached a depth of 3 feet. It was decided by the Committee that the culvert should be of sufficient area to carry away the heaviest fall of rain on record. Having the area and quantity of rainfall given, it was still a matter for consideration and inquiry to ascertain how much of the rainfall would actually enter the culvert, and in what time it would have to be delivered. Fortunately the author was able, partly from experiments in main outfall sewers in other parts of the town, and partly from general observation, to come to a definite conclusion in the matter. It was estimated that the quantity of water to be dealt with in a given time, was one-third of the amount which actually fell in that given time; the remaining two-thirds being accounted for by evaporation and absorption, by being received into rain-water cisterns, and by the fact of there being a certain amount of time allowed before the rain-water can travel along the subsidiary streets and sewers and reach the main sewer. This ratio will necessarily differ as gradients and other circumstances vary, but for a moderately hilly district, such as the one described, it will be found to be reliable.

This storm-water culvert has an independent outlet into the Trent, and enters that river about three-quarters of a mile below the Trent Bridge, and ends at a point on St. Ann's Well Road, near Cathcart Street.

The size of the culvert is 13 feet 6 inches wide, and 9 feet 8 inches high at its lower end; then a 10 foot 6 inch barrel, a 9 foot barrel, and lastly a 6 foot 9 inch barrel. The total length of the culvert, excluding a number of branches, &c., is 10,396 feet, and the fall from its upper end to the Trent is 48 feet. The gradients vary from 1 in 868 to 1 in 91·24. The work of constructing the culvert in and through the low-lying land between the Trent and the railway was one of extreme difficulty. The bottom was of a soft silty nature and full of springs, which necessitated continuous pumping night and day. The crossing under the railway was a work requiring particular care in the execution, in order not to interfere with the heavy traffic on the Midland Railway. A very large portion of the work was executed in tunnel. That through Sneinton Hill was 2750 feet long, and the extreme depth 70 feet; the nett diameter of the tunnel for a 10 foot 6 inch culvert being 12 feet, to allow of 9-inch work. A very considerable length of the tunnel was executed in curves, ranging from about 800 feet radius to one as quick as 150 feet radius. Although the curves rendered the setting out of the lines a work of extreme difficulty, it is satisfactory to say that in no case was the deviation at the place of meeting more than a few inches. The heading was first driven about 6 feet diameter, and afterwards widened out and trimmed to the required width. The rock met with was the very hardest sandstone rock to be found in this neighbourhood, and thoroughly defied any implements but gunpowder. The other tunnel, under the cemetery, was 1345 feet long, and 55 feet deep in its deepest place; fortunately for the contractors the rock in this heading, although hard, was not nearly so hard as that in the former one, and the greater portion of this length of tunnelling was on the straight.

The cost of the work has been about 40,000*l*., and about five millions of bricks have been used in the undertaking. Before the work of laying bricks was commenced, the consent of the Committee was obtained to have a number of bricks tested. Seventeen bricks of different makers were tested by Kirkaldy, of London, and his report showed that the pressure per square foot required to crush the bricks ranged from 112 tons to 280 tons. Tests were also made of the absorption of each brick. The weight was taken accurately when dry, and the brick immersed in water for twenty-four hours and then weighed, and the percentage of water absorbed was obtained in each case. This ranged from 19·1 to 8·6 per cent. The weight of the bricks when dry ranged from 7 lb. 1 oz. to 8 lb. 11 oz., and when saturated they ranged from 7 lb. 14½ oz. to 9 lb. 12¾ oz. A brick from the works of a colliery company near Nottingham, and of which kind about 1½ million were eventually used, stood the highest pressure of any, viz. 280 tons per square foot, and stood second as regards the absorption test, absorbing only 10·3 per cent. of water. The tests may be considered eminently satisfactory, as the average of the whole of the crushing tests was 180 tons per square foot: the authorities, such as Molesworth, Clarke, and Rankine, give the crushing strain of a wire-cut brick at from 52 tons to 127 tons per square foot, whereas the average of the whole of the tests was nearly 50 per cent. above the highest of these amounts.

The result of these experiments showed also that the hand-made local bricks stood very high tests, and maintained the standard which they have hitherto obtained.

The arrangements for separating the sewage and storm-water were designed to suit the requirements of each particular case. It was effected, as a rule, by a weir, so that in ordinary weather the sewage is conveyed into the system of sewers, which eventually deliver the sewage on to the farm, and in time of heavy rains the storm-water overleaps the weir and passes directly into the storm culvert.

The works rendered imperative the carrying of some of the main sewers under the storm culvert by means of iron siphons, which in some cases was a work of considerable difficulty. The contract for the work was carried out by Messrs. Foster and Barry in a most satisfactory manner, in eight months under their contract time.

Sewerage Works Generally.

To keep pace with the opening out of new districts it was necessary that the general system of sewers in those districts should be extended. In some cases new main outfall sewers have been required to be laid, and in others a mere extension of the present system has sufficed. The total length of public sewers laid during five years is sixteen miles. The cost of a portion of this work has been paid for out of revenue and some out of loans borrowed for the purpose.

A considerable amount of these sewers have been laid in ground full of water; it has been generally found necessary, in the case of sewers having a diameter of 18 inches and upwards, to use iron pipes, and in the case of smaller than this size, an earthenware pipe, having a special kind of joint, has been used. The pipe which is now being used extensively in this borough is that known as Hassall's patent, a model of which is laid on the table for inspection; it has the bitumen composition on both spigot and socket, as in the Stanford pipe; instead of this being single it is double, which leaves a groove or annular space between the two faces, which is filled with neat cement. The two faces of bitumen are for the purpose of preventing the cement either running out into the pipe or out of the socket end. The process of laying is as follows: the splayed faces are cleaned from sand and dirt, and covered with a very thin layer of a composition the component parts of which are known only to the patentee; the pipe is driven home in the usual way; there is an oblong opening at the top of the socket end communicating with the groove or annular space previously referred to; this oblong opening is divided into two parts by a piece of clay, and neat cement (not too liquid) is poured down one side of the groove until it rises up at the other side; this method effectually forces out any air or water, and ensures the space being entirely filled with the cement. The author has had these pipes tested by flooding the trench with water which has remained for forty-eight hours, and has never known them to fail to make a thoroughly sound and watertight job.

For house connections, in ground containing water, the pipe known as "Robbins' Cup Joint" has been used; the annular space is filled with neat cement mixed stiff, and the spigot forced into it; the knife edge on the spigot end dividing the cement and forcing the surplus out so as to fill up the annular space; a cement fillet is then formed at end of socket, and the joint is complete. These pipes in iron are very well adapted for use as soil pipes, ventilating pipes, and rainwater pipes.

(V.) Public Street Improvements.

During the last few years a very considerable number of street improvements have been carried into execution.

In consequence of the increase in population, the large number of houses built, and the rapid development of the borough, it was necessary that attention should be given to improving the present means, and also in providing new means of communication between the old part of the borough and the various parts of the new borough, where the rapid extensions have taken place.

The principal improvements which have been brought to a completion during the past five years, are the Lenton and Gregory Boulevards, and a portion of the Radford Boulevard. These three roads, when completed, will form nearly three sides of a square, ensuring a most complete system of communication from east to west by the two first-named roads, which are quite completed. The third portion, or Radford Boulevard, will connect the other two at their western ends, and will complete the communication between north and south on that side of the town. The total length of the roads when finished will be 5569 lineal yards, or upwards of three miles; and only half a mile of this has yet to be completed. The width is 60 feet, with causeways on either side 12 feet wide. The channels are 3 feet wide, paved with 4 inch by 4 inch granite cubes, and the remainder of roadway is macadamised, and was formed in the following way: a layer of ironstone slag was laid for a foundation, 9 inches thick, hand pitched, with the interstices filled in with fine material, and thoroughly rolled and consolidated by the steam-roller; there was then laid a layer 4 inches thick of tarred broken granite, or asphalte macadam, broken to a 2-inch gauge, well rolled, and top coated with a layer ¾ inch thick of tarred fine chippings, and covered off with a layer ½ inch thick of fine Mountsorrel chippings.

The roads are planted with trees on either side at intervals of about 20 yards, having iron tree-guards and also iron water-grates about 5 feet square. The causeways are asphalted, and the sides of the road fenced with wooden pale fencing.

In connection with the Lenton Boulevard Improvement, the river Leen had to be diverted from its natural course into the canal, and thence by an overflow into what is called the Tinkers Leen. This stream was formerly conducted under the canal near the Eastcroft depot by an old brick culvert only about 4 feet diameter. It was necessary to provide for the carrying away of not only the extra water conducted into the stream by this improvement, but also for the proper carrying away of the flood water in the Tinkers Leen, for which purpose the old brick siphon was quite inadequate.

In order to effect this purpose it was decided to put in two iron siphons, each 5 feet 6 inches diameter. The length of the siphon was about 104 feet; the pipes were in 8 feet lengths, and each pipe weighed upwards of 3½ tons. The only thing special about this siphon was the size of the pipes; they were made by the Butterfly Ironworks Company, and were at that time the largest pipes they had ever cast.

The St. Peter's Gate Improvement was one of great benefit to the town, and one having some peculiar features. In order to complete the improvement, about 700 yards of land was required from the churchyard, and this necessitated the removal of the remains of about 1100 persons who were buried on that area. Some of the interments were made as recently as only three years ago. The work of removal was done by our own staff of workmen, entirely at night, and principally under the author's personal superintendence, and he hopes it is the last work of the kind he will ever have the doubtful pleasure of superintending.

The question of the desirability of continuing the present system of burials is perhaps one that scarcely comes within the scope of a paper of this kind, but the using of these churchyards, in places where they are surrounded by a populous district, for the purpose of burials, must have a decided effect upon the health of the community.

Before this improvement was carried out, the author had no very fixed opinion as to the desirability of cremation or otherwise. Since that time he has had a very strong opinion on the subject, that is, that the present system of burying the dead, the result of which is that we are for ever either breathing the gases emanating from the remains of our ancestors, or possibly in some places actually drinking water contaminated by such burials, is one which deserves the utmost censure, and the only apparent means of avoiding such evils is to enforce a proper system of cremation.

The most important of other improvements in the town is the new road from Basford to Bulwell. This improvement consists of an entirely new road from 45 to 50 feet wide for a distance of about 1600 yards, and the widening to 50 feet wide of a road 1500 yards long, which was previously only about 25 feet wide. The road is paved with granite "randoms" on a foundation of concrete, and for a greater portion of the distance trees are planted on either side of the road. The river Leen had to be crossed by the new road, and considerable trouble was experienced in the obtaining sound foundations for the abutments and pier. Running sand was met with at a depth of about 10 feet below the surface, and as this extended for a depth of about 8 or 9 feet below this point, it was decided to drive piles on to the sound ground below the running sand, and build off them; this was done, and effected a considerable saving in cost, as it would have been a most difficult and costly operation to have excavated through the running sand.

The length of this improvement is about 1¾ mile, and the total cost about 30,000*l.*, but towards this sum the Midland Railway Company subscribed about 6000*l.*, thus leaving the cost to the Corporation at, say, 24,000*l.* in round figures.

There are other numerous improvements, but time will not permit of even a passing allusion to them; suffice it to say, however, that during the last five years a sum of upwards of 170,000*l.* has been spent in public street improvements in the borough.

(VI.) PAIL CLOSET SYSTEM.

A description of the works in this town would not be complete without a reference to the pail closet system, which has been adopted to a very considerable extent in this borough. Previous to entering upon a detailed account of the system as carried out here, a description of the Eastcroft depot of the Health Committee, at which place the greater part of the work of the department is done, might not be out of place.

The houses for the superintendent and others are situated at the entrance to the yard adjoining the offices, beyond are the stables, having accommodation for forty-five horses, with granaries, &c., over; there are also cart-sheds, and a large shed adjoining the basin where the contents of the pails are loaded into boats, and where the pails are washed and deodorised; a shoeing forge, wheelwright's shop, and other necessary buildings are also provided; a dry dock for repairing the boats is situated at the end of the basin for loading boats. A siding from the Midland Company's line is laid into the depot, and this, as well as the basin for boats, is supplied with horizontal screens, so as to screen the material before it falls into the trucks or boats.

There is also a 4-cell destructor and other apparatus, which will be fully described later.

The pail system was first introduced into this town about twelve years ago by the late Mr. William Richards, Chief Sanitary Inspector. This system has grown rapidly during the last few years, and in consequence of the rapid increase in population has assumed very considerable proportions. There are at the present time 31,155 pail closets in use in the borough, and the pails are emptied once or twice a week in the majority of cases, but in some instances are emptied daily. The pails are old oak casks, cut in halves, and new oak bottoms put in same, handles are supplied, and the whole well tarred, and are obtained under a contract at 2*s.* 10*d.* each, delivered at the Eastcroft depot. The work of changing the pails is done at night between the hours of 10 P.M. and 6 A.M., and the full pails brought down to the various depots. At the Eastcroft the contents are thrown into screens, and the screened portions fall through either into the boats or into the trucks as the case may be, and what will not pass through the screens is taken to the destructors. The pails are washed, deodorised, and are sent out again.

For the week ending 2nd May, 28,532 pails were brought into the Eastcroft depot, and during that week no less than 45,418 pails were brought into the whole of the depots in the borough.

To show the increase in the work, the number of pails changed in the borough in 1881, was 1,294,860; whereas, in 1884, the number was 2,240,899, or an increase in four years of 73 per cent. The weekly average of removal of pails was 24,901 in 1881, and 43,094 in 1884, and it will be seen that this is now rapidly on the increase, as in the week ending 2nd May the number of removals was 45,418, or an increase of 2324 on the average of last year.

The average life of a pail is considered to be about three or four years, but during that time it has to receive a considerable amount of repairs.

The total weight of material brought in by pails during the year 1884 was about 40,000 tons; besides this there is the material brought in from the ashpits and privies, a large number of which still exist in the Lenton and Basford districts of the borough.

The price per ton obtained for the manure is, generally speaking, about 1*s.* 6*d.* per ton in boat or on rail, and last year the sum of 7145*l.* was obtained for sales of manure, and the total amount sold as follows:—

By Boat	33,182	tons.
„ Rail	25,840	„
„ Land Sale	16,000	„
Total	75,022	„

There are also nearly 6000 tons of dry material taken into the destructor and there destroyed (that is, burnt). These destructors are on Fryer's principle, and this plant consists of four destructor cells, and a destructor boiler, an elevator and rotary screen, a mortar mill, and a horizontal engine to drive the machinery. The works were planned and arranged by Messrs. Manlove, Alliott and Fryer, and a very cursory glance at them will show the errors in the arrangement. In the first place, the heat from the four destructor cells is wasted and sent up the chimney without doing any useful work, and a separate cell provided to burn material in order to provide heat for the multitubular boiler; in the second place an ordinary bucket-elevator is not the most fit apparatus for delivering properly and safely a material of such varied character as is here burnt in these destructors. Nothing in the author's opinion equals a cart-road or approach, as he thinks that the less machinery there is on works of this kind the more successful they are likely to be. The destructor cells do their work well and thoroughly, and there is at present no other arrangement of furnace known which answers the purpose better. The chimney from the cells is 160 feet high above ground level, and considerable difficulty was encountered in obtaining a secure foundation for it; a depth of 27 feet below the ground level was excavated before rock was reached. The foundation bed was 30 feet square of concrete, and the cost of the chimney was about 1400*l.* or 7*l.* 10*s.* per foot in height, reckoned from bottom of foundations. The chimney has a base 13 feet square at ground level, and above that is octagonal in shape, and the diameter of flue at top is 5 feet.

The rotary screen is for separating the fine particles from the coarser, the latter enter the cells, and the former are taken and delivered into boats and trucks to mix with and bring to a proper consistency the wet material which sometimes comes in the pails.

The mortar mill is not used for making mortar, but for grinding up fish, offal, fine ashes, &c., into a concentrated manure, which is sold at 2*s.* 6*d.* per ton. The depot is supplied with water from a well sunk on the premises, from which water is lifted by a Tangye's pump into a tank holding about 12,000 gallons of water. At night the works are lighted by the electric light: there are ten lamps, each 2000 candle power, supplied from a dynamo in the engine-house. The whole of the steam power required, both for elevator, screen, mortar mill, pump and dynamo is obtained from the destructor boiler.

The movable plant required to carry on this work is necessarily somewhat large; there are 49 vans and drays, 46 two-wheeled carts, and 64 horses belonging to the Committee; it is necessary sometimes to hire horses, as the work fluctuates to a certain degree.

The author has refrained from giving any decided opinion on this pail closet system, for obvious reasons; it is an undoubted step onward, when compared with the old midden system, but that the pail system is at present perfect cannot be maintained by any one, and it is hoped that some system may be devised which will be as much in advance of the pail system, as the latter was in advance of the old midden system. There are many difficulties to contend with, among others the obtaining of suitable places for depots, and in large towns these must be moderately numerous; a depot may, when chosen, be situated among and surrounded by fields, but these in course of time become built upon, and complaints, whether justly or unjustly, are sure to be made of nuisances arising from the works.

Lastly, as regards works already designed and about to be carried into execution, there is time only to name the principal one, that is the new cattle market, which, with the approaches, sidings, and other works, will cover an area of about 9 acres, and will cost about 30,000*l.*: contracts have been advertised for, and the work will be pushed on with all possible speed, as a large portion of the present cattle market is being occupied by the new police courts and buildings which are now being erected.

Having as briefly as possible described the principal works and operations under the various headings enumerated at the commencement, it would be interesting to summarise this work in two ways, (1) as regards cost, and (2) showing the amount of the various kinds of work executed.

(1.) As regards cost:—

	£
On private street improvement works, repaid by owners, has been expended about	210,000
On repairs of public highways, paving, kerbing, and flagging of public streets, maintaining and repairing sewers, scavenging and watering	166,000
On the extension of the sewerage system, and the construction of storm-water culvert	60,000
On special contract works, such as the extension of the Eastcroft depots of the Works and Ways and Health Committees, and other similar and sundry works	60,000
On public street improvements	171,000
Or a total in five years (excluding the work of the Health Committee) of	667,000

(2.) Showing the amount of the various kinds of work executed:—

Number of private streets dealt with			305
Length of private streets	38,555	yards, or	22 miles.
Sewers in public and private streets ..	51,493	”	30 ”
Kerbing	117,918	”	67 ”
New granite paving	440,131	”	91 acres.
Old granite paving taken up and repaved	103,985	”	21½ ”
New flagging	101,157	”	21 ”
Wood paving	13,234	”	2¾ ”
Brick paving	49,049	”	10 ”
Asphalte footpaths	123,960	”	25 ”
Mastic asphalte	1,250	”	
Concrete carriageway	1,030	”	
Asphalte macadam carriageways ..	150,000	”	31 ”
Weight of broken stone used on repairs of macadam roadways			62,200 tons.
Number of houses erected and inspected			13,500
Number of drain connections laid in from sewers to buildings			4,500

In conclusion, the author feels that he has to ask for the indulgence of the Members of the Association, inasmuch as he is afraid that the subject has not been dealt with in that comprehensive way in which it ought to have been; he must shelter himself behind the plea that the time at his disposal in the past fortnight, since the meeting in Nottingham was decided upon, has been very limited, in consequence of the demands made upon his time by official duties; he hopes, however, that an account of the work carried out under his direction in this town, for a short period, has not been found altogether uninteresting.

DISCUSSION.

Mr. **Gordon**: The paper read by Mr. Brown is so exhaustive, and teems with such excellent facts which will be useful to us all, that I can only say I am sorry it was not printed beforehand, in order that we might have expressed more fully the feelings of gratitude I am sure we all entertain towards Mr. Brown for having produced the paper he has read to-day. Nottingham, it will be confessed by many gentlemen present, if not by the whole of us, is one of those towns of which we are very often reminded in our committees; at any rate, I know we very often hear of it in some of our committees in Leicester. I have had the pleasure of inspecting before some of the works which we have looked over to-day; and our worthy President, whom we are pleased to see here in the chair, has not been behindhand in availing himself previously of the opportunity of seeing what can be done in Nottingham with reference to many questions which occupy the attention of us all as sanitary engineers. Whether it be with respect to street paving, dealing with the pail system, the construction of footways, or the erection of stables and the arrangements necessary for carrying on large works where the corporation provide their own staff of men and horses, it is constantly said in our committees, "Let the surveyor go to Nottingham, and see what they are doing there." Sometimes, indeed, one is tempted to think that the chairmen of some of our sub-committees have "Nottingham on the brain." But, gentlemen, I think every Member of this Association who has been here to-day, and who has not had the opportunity of seeing before the works which we have seen, will have come to the conclusion that the committees for which we act are not far wrong when they tell us to see how they do these things in Nottingham. Everything we have seen to-day has been of the very best of its kind. We have seen, last of all, how they manage to lay down footways with concrete. Many years ago I have seen this system employed on the Continent, chiefly by Italian workmen, in a manner I had not seen equalled in England until recently; but I can say that I have not seen better work anywhere than I have seen to-day, in this particular line. We have also had shown to us asphalte footpaths and tar-macadam roads, the stables and depots, the manipulation of the contents of the pails, and the mode of dealing with the refuse by destructors. All these things are excellent in their way, and have been carried out to some extent apparently regardless of cost, in an admirable manner, by Mr. Brown. The facts he has given of the largeness of the works over which he has control seem to stagger one, even if one comes from towns considered to be large, and with works approaching to some extent in magnitude the works at Nottingham. What, then, must it be to those who represent towns of more moderate size, to hear Mr. Brown speak of 146 miles of roads, and his statement at the end of his paper that in Nottingham they have expended nearly three-quarters of a million sterling in five years. We know perfectly well the amount of energy, ability, and brain-work which has had to be brought to bear in order to bring all these things to the successful issue we have seen to-day. I was very glad, however, to find in Mr. Brown's paper some little indication of his own opinion with regard to certain principles. I allude more particularly to—what shall I call it? Well, some gentlemen have described it before, as "that most abominable system, the pail system." Whilst I represent a town where the pail system is partly adopted, I do not hesitate, in my capacity to-day as a Member of this Association—for the Members of this Association must have their innings also as well as corporations and chairmen of committees—to express my opinion that the system is wrong from beginning to end. I acknowledge that in Nottingham it is carried out in probably the most perfect manner to be found in any town in England, not excepting even Manchester and Birmingham; and you know very well that we saw in Birmingham three years ago excellent arrangements for dealing with excreta as it was collected in pails. The authorities have spent there, I believe, 100,000*l.* in works to deal with the excreta so collected, and convert it into a saleable manure in the shape of a powder; but if you inquire behind the scenes, and test this question at Birmingham to the bottom, you will find I am not using too strong language when I say that the system is a mistake from beginning to end. At Nottingham, the system is improved by allowing the ashes from the cottages where these pails are used to be put in and mixed direct with the contents of the pails, I believe by lifting the seats. That to some extent gets over one of my objections to the system, and that is, that in towns where it is generally applied, and where the pails are collected twice a week (although in the majority of towns they are only collected once a week), the excreta is allowed to stand until in my opinion it is in a condition highly dangerous to the health of the people who use the pails. We all know, and it is perfectly well understood, that in advising respecting any system of dealing with the sewage of a town on the water-carriage principle, you must by some means get rid of the excreta out of the precincts of the town within twenty-four hours, otherwise you will have putrefaction setting up. If, then, you allow pails of sewage to remain for four or five days without deodorisation, I contend that the pail system is dangerous to the public. By mixing in ashes you get over the difficulty to some extent, by deodorising the contents of the pails; and therefore in that direction the Nottingham system is an improvement. I hope the members of the Nottingham Corporation will not consider any expressions of disapproval of the system by Members of this Association any reflection upon themselves. I daresay they started with the best intentions—as those who preceded me at Leicester did—of lessening the difficulty of dealing with the sewage at the outfall, and getting rid also of the ashpit and midden system; and there is no doubt that the pail system is a great improvement upon the latter. But what do you gain by it, supposing you have also to have a sewerage system? What would be the extra cost of carrying away the whole of the excreta to the sewage farm? Why, practically nothing at all. The quantity of excreta you collect in the pails can only amount at the most to 2½ lb. per head per day, but is in reality less than this, from causes which can be explained. This represents only an eighteenth part of the sewage you have to deal with, taking it at 20 gallons per head, and there are few, if any, towns which do not largely exceed this. I think the pail system is a mistake. I am glad Mr. Brown has given us the opportunity of expressing our opinion on it, and I hope the condemnation of it by this Association may prove a sufficient warning to other towns contemplating in any way its adoption. That is my reason for having availed myself of this opportunity of expressing my opinion, but I am sure every Member of this Association will agree with me when I say that we are unanimously and individually indebted to Mr. Brown for the valuable paper which he has read at this meeting.

Mr. LOBLEY: Mr. Brown in his paper referred to new streets being taken over by the local authority, and alluded to some district which had adopted the plan of requiring owners to make the streets first and then hand them over to the authority. I suppose that refers only to the laying out of new estates. If any one present knows anything of the system, I shall be glad to hear where it is practised, and under what law it is carried out. I am not alluding to isolated cases, where owners have notices served upon them and then do the work themselves. This is extremely rare, and only occurs when two or three persons only own the same street. With regard to owners making streets, and then the authority adopting them. When an owner lays out a field, the entire completion of the streets is very rare. Before the houses are built, there is naturally a reluctance to complete footpaths, if not carriageways, but it is ruled in the West Ham case that an authority cannot take over a street until everything has been done and completed. I have introduced a plan, which has been in operation nine years, and works extremely well with regard to laying out an estate for new streets. It is to require the owner of the property, before he sells any building lots in a new street, to pay the money necessary to finish it to the authority. Thus the cumbrous machinery of the 150th section of the Public Health Act is rendered unnecessary, whilst the street is left in order and the footpath completed as houses are built. Mr. Brown has alluded to the subject of cremation. This is, of course, a very important matter, but it appears to me that the attention of sanitarians might be usefully diverted from cremation to something which may produce good results in our own time. Cremation may be the future mode of disposing of the dead, but one thing is quite certain, it will not be universally adopted in our lifetime. The mode of cremating a body makes the system a costly one, and therefore could only be adopted by the rich, even if it became more general. Before, however, it can be adopted at all, there will be years of controversy, and until then graveyards will be extending and interments be continued. I should like to throw out a suggestion for discussion, which could be adopted at once and would yield very good results, and that is cremation, not by fire, but by lime. A system of burying in quicklime would do away with many of the evils which now exist from burying the dead in the ground. I will not dilate on the pail system; that would be like thrashing a dead horse. We have had our innings years ago; having passed through the throes of the pail system; we have once adopted it, but we have for some time now abandoned it.

The President: I regret that time does not permit us to continue this discussion now, for we must not disappoint His Worship the Mayor, who has so generously and hospitably invited us to dine with him. I would, therefore, ask those who have anything further to say on Mr. Brown's paper, if they will kindly send their comments to the Secretary in writing; they will then be inserted in the report of the proceedings in the usual way. Before I sit down, I will ask you to pass a vote of thanks to Mr. Brown for his very able paper; and I would ask you also to adopt a similar vote of thanks to the Mayor and Corporation of Nottingham for their courtesy in letting us have the use of the Council Chamber for our meeting, and especially to Alderman Ford and the other gentlemen who have attended here to-day, and have endeavoured to show us the best they have in Nottingham that was likely to interest us.

Mr. BROWN: I am very much obliged to you for passing a vote of thanks to me for the paper read this morning. I am sorry I had not a longer time to prepare the paper, which I am afraid is not sufficiently comprehensive. It has also been a drawback that the paper has not been previously printed and circulated amongst the Members of the Association in the usual way. I hope this will not be the last time the Association will come to Nottingham, and that then we shall have something more to show you than we have been able to show you to-day.

During the day the Members visited Sir J. Oldknow's Lace Manufactory; the Works and Ways Depots, Stables, &c.; Health Depot; Destructor and Pail Closet System; The London Road Paving Works; and the Trent Bridge. Mr. Brown very carefully pointed out and explained the various matters of interest mentioned in his paper. In the evening the Members were entertained at dinner by the Mayor at the 'George' Hotel.

ANNUAL MEETING IN LONDON,

June 25th, 26th, and 27th, 1885.

ADDRESS OF THE PRESIDENT,

R. Vawser, M. Inst. C.E., Manchester.

Gentlemen,—At our provincial meetings it has been the agreeable duty of your newly-elected President, to describe the works completed or in progress in the town he represented; but a meeting in London affords an opportunity to discuss matters of general, rather than local interest, and I shall endeavour, while availing myself of the time-honoured custom of delivering a presidential address, to speak generally of subjects interesting to the Sanitary and Municipal Surveyor.

Permit me first to thank the Association for placing me in the presidential chair, a position that has been honourably filled by some of our most distinguished Members. I accept the position with a deep feeling of responsibility, and an earnest desire to sustain the credit of the Association, but the first duty I have undertaken—the preparation of this address—I find embarrassing; not on account of a deficiency of subjects for discussion, but rather because I cannot do full justice to them. I trust that the ensuing year will be a successful one, and that when I vacate the chair, the Association will be more widely known, better appreciated, and still more useful.

It is a subject of satisfaction to those who have watched the growth of the Association, that an attempt will be made this year to institute a system of voluntary examinations for those who seek to follow this branch of the profession. The great variety of subjects upon which a municipal surveyor advises his authority, requires special training and prolonged study; and none can possibly fill the office of a local surveyor, in any place, however small, with credit to himself and advantage to his employers, without careful training and preparation, and the object of the examination about to be instituted, will be to test the capacity of the candidate and his qualifications for such an office; but will not, and cannot be a guarantee that the candidate is qualified for every emergency, or for any particular sphere of duty, the ultimate test will still be experience, and without actual experience no surveyor can succeed.

At our meeting in Birmingham in 1874 a councillor from the town I then represented, after listening to an interesting discussion on the duties and qualifications of town surveyors, inquired if sufficient men of the requisite ability were forthcoming, provided local authorities were convinced it was their interest to employ them; happily there is now no doubt of it, and this Association may in some measure have contributed to the result.

When the Public Health Act of 1848 was passed, and for some years afterwards, a local surveyor was rarely called upon to undertake any work more difficult than a new sewer, or a few yards of paving; even the most advanced sanitarians hardly contemplated any treatment of the sewage other than throwing it into the nearest watercourse, and only in comparatively recent years has it become generally recognised that sewage purification is imperative.

The works at Tottenham and Leicester erected some thirty years ago for treating sewage with lime, were the first of the kind; and notwithstanding the costly experiments that have been undertaken, and the official and other books that have been written, we are apparently no nearer a really satisfactory result than at the beginning, and precipitation by lime, for all practical purposes, yields as good an effluent as any other process.

Although the purification of sewage is attended with much difficulty, and is involved in uncertainty, I think chemical precipitation will form the basis of the treatment which ultimately proves to be best, but whether treatment by chemicals will be perfected so as to dispense with subsequent filtration or application to land, is a question not ripe for solution. Many causes have contributed to make sewage purification unsuccessful, but none more so than the idea that once so largely prevailed, that sewage purification would pay; and instead of making efforts to secure the best effluent at the least expense, it has been sought to make a profit, the purity of the effluent being considered of secondary importance. If the failures and experience of the past have not altogether been thrown away, it must now be evident that a profit from sewage and a pure effluent are inconsistent with each other, and it cannot be too strongly impressed upon sanitary authorities, that except under abnormal conditions sewage purification in any form cannot pay. The prospect of making a profit has often led to the adoption of schemes that could not be justified on purely engineering grounds, and it must ever remain a matter of regret that this fact has not found a more prominent place in the official Blue Books.

Sewage can be applied to land successfully if it is delivered as and when it is wanted, but this is not possible in ordinary cases, and consequently irrigation alone is not adapted for the purification of town sewage, and other means of treatment must be at hand; it makes no material difference to the main fact whether the separate system of drainage is carried out or not.

While expressing an opinion unfavourable to the universal application of irrigation, I do not desire the general adoption of any other system; all experience shows that each place must be considered on its own merits, and provided the engineer looks carefully to the purity of the effluent, and to the avoidance of all nuisance, he will not be wrong. The difficulty arising from accumulations of sludge is not a conclusive argument against a precipitation scheme, nor is a general allegation that the produce of a sewage farm cannot be disposed of to advantage, an insuperable objection to an irrigation scheme, but both of these considerations must have their due weight.

The difficulty of disposing of the green produce of the farm to advantage constitutes a great objection to irrigation; there is seldom a demand for such produce corresponding with the supply, and it is consequently to a large extent valueless. I am favoured by Mr. G. Eaton, Borough Surveyor, Crewe, with particulars of some experiments on the Crewe farm, which seem to show that by converting the green crops into "ensilage" the whole of it can be profitably utilised; this system if it proves successful after further trials is likely to have an important bearing on the agricultural features of a sewage farm, but will probably involve new arrangements for cultivation, and for stocking the farm, as it would appear cattle should be kept on the farm in large numbers in order that the system may be worked to advantage.

"Ensilage" consists of rye-grass or other green produce stored and preserved in a pit called a "silo." It may be deposited in the silo just as it is mown, but it is usually cut by a sort of chaff-cutting machine. The grass can be carted and stored immediately it is mown, whatever the state of the weather, and in some experiments, samples cut in wet weather have been preserved better than those collected dry. The silo is a brick or concrete structure, partly below the level of the ground for convenience, and is usually constructed to contain from 50 to 100 tons of ensilage.

When it is desired to fill a silo, a cutting machine is fixed over the pit, and carts follow the mowing machine and convey the grass at once to the cutter, from which it drops into the pit, where it is levelled and trodden by two or three men. When the silo is nearly full, its contents are covered with planks and weighted to 120 lb. per sq. foot, and in a few days will have shrunk to nearly half their original bulk; the process of filling is then resumed until it is again full, when the weighting is continued as before.

It does not appear that cattle are fed with ensilage alone, but it is mixed with one-third its bulk of dry food, such as chopped straw or hay, and in these proportions is given continuously.

To show the result of feeding with ensilage and hay, as compared with hay and turnips, on the yield of milk, an experiment was made as follows:—

WITH ENSILAGE AND HAY.

	£	*s.*	*d.*
10 cwt. 0 qrs. 10 lb. ensilage, equal to 41 lb. per day, at 9*d.*	0	7	6
2 „ 3 „ 4 „ hay „ „ 11 „ „ „ 3*s.*	0	8	4
68 lb. turnips	0	0	5
3 bush. 18 lb. oats equal to 6 lb. per day, at 3*s.*	0	10	0
	£1	6	3

The two cows gave 1007 lb. milk during the two weeks.

WITH HAY AND TURNIPS.

	£	*s.*	*d.*
5 cwt. 3 qrs. 12 lb. hay, or 23 lb. per day, at 3*s.* ..	0	17	6
3 „ 3 „ 0 „ turnips, or 15 „ „ „ 9*d.* ..	0	2	10
3 bush. 18 lb. oats, or 6 „ „ „ 3*s.* ..	0	10	0
	£1	10	4

The two cows gave 917 lb. milk during the two weeks.

	£	*s.*	*d.*
Extra quantity of milk obtained by feeding with ensilage = 90 lb. .. .. value	0	6	0
Cost of keep, Ensilage = 4*s.* 1*d.* less	0	4	1
Showing a total in favour of ensilage feeding of	£0	10	1

A test was likewise made from 25th February to 24th March in the present year, to ascertain the comparative increase in weight of cattle fed with ensilage, as compared with those fed with hay, and it was found that the increase of weight in fourteen days with ensilage averaged 58 lb. per head, while the increase of those fed with hay, averaged only 15 lb. per head.

These results are satisfactory, and as the process is receiving the attention of agricultural authorities, we are likely to hear more of it. A great deal of general information upon ensilage can be obtained in farming counties, and a commission is collecting information; the subject cannot fail to be interesting to those who have followed the sewage question.

Sir J. B. Lawes advocates the discharge of sewage into the sea, upon the ground that its value as food for fish exceeds its value in any other form; let us hope this view will not meet with general adoption until it has been ascertained beyond dispute that other and greater evils do not accompany that mode of disposal. Engineers in the Midland counties may then find agreeable occupation in constructing main sewers to the seaboard.

In connection with sewage purification works, and indeed with any works involving the acquisition of land, it is unfortunate that special facilities are not afforded to local authorities to enable them to acquire land at its fair value, and without the enormous contingent expenses inseparable from purchases under the Lands Clauses Acts.

The Rivers Pollution Prevention Act 1876, at first gave a great impetus to sanitary matters, and to sewage purification especially, but the general result has not been so satisfactory as was expected. This is not so much due to defects in the Act, which is sufficiently drastic for a first attempt, as to the imperfect way in which it is enforced; if the existing Act were made compulsory, and the obligation placed upon some one to enforce it by prosecuting defaulting authorities and manufacturers at the public expense, a better result would follow, and in a few years our rivers would be better than common cesspools. Unfortunately moderate legislation on social and sanitary questions is extremely difficult to attain. I refer to such questions as the Floods Bill and the Rivers Pollution Bill are intended to provide for: everyday experience points to the necessity of moving cautiously with this class of legislation, but the same experience suggests that we should move and not remain at a standstill altogether. The Rivers Pollution

Bill of this present session would have completely destroyed many industries in this country if it had become law, and I venture to think that incautious attempts at this class of legislation are likely to delay rather than promote the object in view. The Bill,—which was based upon the recommendations of the Rivers Pollution Commissioners—prohibited the discharge into any stream, of water containing 1 part of organic matter, or 3 parts of mineral matter in 100,000 parts of liquid, also any water showing discoloration when standing 1 inch deep in a white porcelain dish. If these tests were rigidly enforced against companies and corporations supplying water for domestic purposes, how few would escape conviction; and to specify such a standard against waste liquids and sewage effluent is to create a reasonable opposition from all interests threatened, and even from persons most anxious to support the general policy of the Bill. Were the existing Act made compulsory, and were it efficiently enforced for a few years, improved methods of manufacture would be gradually introduced, and when the time arrived for more stringent legislation it would not be seriously opposed.

The Floods Bill will probably afford considerable employment, and I suggest that when it is brought forward again it should be carefully studied; and the efforts of this Association may be usefully employed in preparing suggestions likely to render the Bill acceptable. Many attempts at legislation which end in disappointment, might be brought to a successful issue if the Bills were drafted with the one sole object of removing prominent and notorious abuses. Permissive legislation has failed, but progressive legislation which provides for the efficient enforcement of moderate provisions is urgently required. Possibly occasional discussions on subjects within the sphere of our professional duties might induce the authorities we represent to exercise pressure on Members in Parliament and the Local Government Board.

It would be impossible to give a complete list of the many amendments and additions to the Public Health Act which are becoming urgent, but the limited and uncertain powers possessed by sanitary authorities with respect to new buildings, and building bye-laws are very seriously felt. Probably we must wait many years for further sanitary legislation; I confess I do not see occasion for delay in dealing with pressing matters, and if a Bill were presented to Parliament, backed by the weight and responsibility of the Local Government Board, it is difficult to believe Parliament would reject it. Private Bills are passed every session conferring exceptional powers on authorities that apply for them, and most of the powers so obtained are equally necessary in other districts throughout the country.

The report of the Commissioners appointed to inquire into the housing of the working classes has been produced most opportunely, and contains much valuable information, and practical suggestions of professional interest. I do not propose to anticipate the discussion on this subject which will follow, but I believe that in future there will be a greater tendency towards a concentration of the population than in the past; the trade of the country now admits of only the smallest possible profit, and the cost of production must be reduced to a minimum; already a number of special trades which had been established in remote parts of the country have been closed, and where others are established it is in urban districts, where regular supplies of clean water can be obtained, and where a reduced cost of carriage, cheap fuel, and other advantages render a small profit possible. I think therefore we must expect a more rapid gravitation of rural populations towards the towns, and this should be kept in mind when advising upon streets, building bye-laws, sewage treatment, and kindred subjects.

While the question of ameliorating the condition of the artisan classes is under consideration, it would be well if the further erection of back-to-back cottages were suspended. Until quite recently dwellings of this description were erected in most of the large towns, but I should be glad to hear the practice has been discontinued, otherwise it will aggravate a difficulty that will have to be faced some day.

A glance at the last two or three volumes of our 'Proceedings' reminds me of another branch of professional duty that has lately been developed, viz. Tramways. The introduction of steam traction has gone far to revolutionise road locomotion, and many small towns not large enough to support a tramway, form part of a system connecting many towns together. The fact that 330,000,000 passengers were carried by street tramways last year is proof of the growth of this enterprise.

The cholera in Europe last year, its presence now in Spain, and its expected visit to our own shores this year, endows the question of public health with a degree of importance which would scarcely have been otherwise attained, and sanitary authorities should be urged to adopt every reasonable precaution by the erection of hospitals, disinfecting establishments, and mortuaries; and by improved supplies of water, the ventilation, flushing and disinfection of sewers, and the like. The prompt removal of every species of nuisance is also imperative, and it may become a question for inquiry, whether, as sewage purification is indispensable everywhere, it is desirable to incur the additional expense of the pail system where it is in use; and whether, considering the annoyance if not the nuisance endured by residents in the neighbourhoods where the pails are prepared, it would not be well to reconsider the whole question of pails as compared with water carriage, and to abandon the former unless some distinct advantage is gained by retaining it.

The question of bye-laws, and the influence of a healthy house, cannot be discussed now, but their importance cannot be overrated, and the public require the guidance of the surveyor on doubtful questions: upon this I will venture the opinion, that the result would be more satisfactory if a surveyor were supplied with suitably trained assistants, and were required to make systematic and periodical inspection of houses, rather than this duty should be performed by persons who have no official responsibility. In order to ensure occasional inspection without intruding on the privacy of the occupier, a new tenant should not be allowed to take possession of any premises until a thorough inspection had been made, and as houses are usually vacated every few years, the adoption of this rule would at any rate ensure occasional inspection at a time when it could be made thoroughly, and without inconvenience; an inspection to be complete should include gas pipes and fittings as well as drains; leaky gas pipes, besides being very offensive, poison the atmosphere, produce bad health, and render those who breathe it more susceptible to disease.

There are many subjects claiming the attention of a local surveyor which cannot be touched without inflicting a much longer address than the time at our disposal justifies, but I venture to hope that discussions of general and professional interest will be arranged at the various district meetings during the ensuing year, and that the Association will endeavour to influence public opinion on matters of public health, and upon other questions with which we are brought into contact by our professional duties.

STREET LIGHTING.

By W. SANTO CRIMP, Surveyor to the Local Board,
Wimbledon.

As the district of Wimbledon is at present lighted by means of oil, as regards the street lamps, and as a part of the district has been experimentally lighted by means of electricity, and as the author receives frequent communications from Town Surveyors requesting information on these various methods of lighting the street lamps, it is hoped a short paper on the subject may be of interest.

Wimbledon is one of the most important of the London suburbs, the area being 3220 acres, the population exceeds 20,000, the rateable value is about 170,000*l.*, and the length of the public and private roads are about 22 and 20 miles respectively, and the number of street lights 361. The district is essentially of a residential character, there being no factories of importance.

The street illuminant was originally gas, but the high rate charged by the Company for its supply led the Local Authority to seek other means of lighting.

Electricity.

During the months of March, April, May, and June, 1884, a length of about two miles of street was experimentally lighted by means of the electric light, Mr. Preece, F.R.S., personally superintending the arrangements. A portable steam-engine of 8 N.H.P. was hired from Messrs. Wallis and Stevens of Basingstoke. It was one of their standard pattern, fitted with sensitive governors.

The engine was connected to a Hochhausen dynamo machine, lent for the purpose by Mr. H. Edmunds.

Two circuits, partially of solid No. 8 copper, and of standard copper wire made up of seven No. 16's and giving a resistance of two ohms per mile, were supported on insulators fixed on ordinary scaffold poles placed at regular distances of 100 feet apart. Incandescent or glow lamps only were used, and these were of 10, 20, 30, 50, 60, and 90 candle-power, and by various makers, including Swan, Woodhouse and Rawson, Bernstein, and Maxim. The distance apart at which the lamps were placed varied from 100 feet to 300 feet, and the height above the ground was also varied.

A great number of different kinds of reflectors were tried, those of Mr. Trotter being especially good, whilst excellent results were also attained by using bright nickel-plated iron discs, 18 inches in diameter.

In order to ascertain the cost of working, 76 lamps of 20 candle-power were worked an average of six hours per night for eight weeks. The total cost, inclusive of every expense except rent of buildings, was 40*l.* 4*s.* 6*d.*, and this sum divided by the lamps and by the number of hours, gives per 20 candle-power lamp per hour 0·378*d.* The life of a lamp was reckoned equal to 1000 hours, and 10 per cent. depreciation was also charged on the remaining plant. But the same staff could have attended to 400 lamps, and had that number of lamps been used the cost would have been reduced to about 0·2*d.* per lamp per hour, or with rent, as nearly as possible ¼*d.*, or less than gas when a 5-feet burner is used and gas is 4*s.* 2*d.* per 1000 cubic feet, the price charged by the Company supplying the district; but in this calculation allowance has not been made for capital outlay (beyond 10 per cent. depreciation), supervision, accident, insurance, &c., items which would probably increase the cost to ½*d.* per 20 candle lamp per hour; thus, taking 10 candle-power as the unit, the cost of ¼*d.* per unit per hour may be safely relied on, and as the number of hours per annum the lamps are alight averages 4000, the cost per unit per annum will be 4*l.* 13*s.* With regard to the results, it may be mentioned that the most favourable were obtained from Messrs. Woodhouse and Rawson's 50 candle-power lamp: but comparatively with gas, the 10 candle-power lamp was as good as an average 5-feet burner, the 20 candle-power much superior. But while the 10 candle lamp is ample for the outlying parts of a district, main thoroughfares should have 20 or 50 candle-power lamps, accordingly as their width and requirements vary. A most important fact in connection with the glow lamp is the readiness with which the strength of the light may be regulated by the size of the filament; thus, lamps of any degree of brilliancy up to

100 candle-power may be placed where required most. This form of lamp may also be said to be devoid of all the defects of oil and gas; given a good motor, the light is absolutely steady, and it can be regulated, controlled, turned on or off at pleasure. It is independent of the weather, age alone deteriorates the carbon filament until it breaks, its life however averages 1000 hours, and it is replaced with ease. In short it is difficult to conceive of a more beautiful illuminant for our streets than the glow lamp, where the expense can be easily borne by the ratepayers.

Arc lamps were not tried, as their intense and concentrated brilliancy was not considered suitable for the practical purposes of street lighting in such a district as Wimbledon, where streets 40 feet in width are the rule.

OIL.

From electricity to oil seems to be as retrograde a step as can possibly be conceived, and yet even oil has its merits, the chief of which is that it does place the local authorities in a position to demand gas at reasonable cost from the too greedy private gas companies. All the street lamps in this district have been lighted by means of oil for a period of nearly three years, the first two by a contractor, the last by the Local Board themselves. At the termination of the contractors' term in August 1884, the Board purchased from them all the lamps, ladders, cans, &c., at a cost of about 45*l.*

The author has before stated that the number of lamps is 361. The greater part have wicks 1⅜ inch in width, and the chimney or globe is that known as the "pine." About twenty of Rettich's Mitrailleuse burners are employed in the principal positions. These lamps are undoubtedly far superior to the ordinary gas burner of 5 cubic feet per hour, the cost per lamp per annum being about 10*s.* more than the flat-wick lamp.

The light given by all the lamps when in good order is very steady, and averages 12 candles, although the slight yellow tinge of the flame does not impress one with the idea of brilliancy when compared with good gas, or with electricity. On the other hand, the lights are not affected by the weather to the extent that gas lights are. With regard to the all-important question of cost, the author is able to furnish the exact cost per lamp per annum, based on the experience of his eight months' lighting of the lamps, viz:—

	Per Lamp per Annum. £	s.	d.
Oil, waste, cottons, globes, &c.	1	6	0
Labour	1	2	4
Repairs to lamps, lanterns, and new oil vessels	0	3	1
Total Cost	£2	11	5

It should be observed that the district is a large one, and that the lamps are widely scattered, hence in some towns there might be a saving in the item for labour. The lamps are alight from sunset to sunrise.

The oil is procured from a local oil merchant, the price given being 5 per cent. above market price. "Royal Daylight" and "Tea Rose" are the brands invariably used, and the oil is of excellent quality.

GAS.

A paper has been already printed in Volume VIII. of the Minutes; moreover, gas is so universally used, and its cost is so much dependent on the pleasure or special circumstances of the all-powerful company supplying the particular district, that it is not necessary to enlarge on the subject in a short paper. The author would merely say that in his district, the price of gas is 4*s.* 2*d.* per 1000 feet, that the company have recently made an offer to light the street lamps at 3*s.* 6*d.* per 1000 feet, but not including labour, which would bring the cost to 4*l.* 10*s.* per lamp per annum, the price formerly charged being 4*l.* 2*s.* per lamp, the lights being extinguished at 1 A.M. It will be seen therefore, that petroleum is enormously cheaper in this district than gas, and the fact that it has been in use for nearly three years shows that the ratepayers are not anxious to revert to gas.

Since the author prepared this paper, it has occurred to him that with a title of "Street Lighting," a paper on the subject would necessarily be incomplete without some further remarks on gas lighting, and, having received some valuable information from Mr. De Courcy Meade on this subject, the author would like to add to the original paper additional details on this system of lighting.

The usual mode of payment for lighting street lamps, is that of a fixed sum per lamp per annum, the burners, except for large open spaces and important thoroughfares, being of the "bat's-wing" type, with diaphragm governors, passing about 5 cubic feet per hour, but there are a number of different kinds of burners in use, those of Sugg & Co. being particularly good.

The other mode of payment is by the average meter system, when meters are placed at any desired interval, say at every fifteenth lamp, the meters being under the footway in a suitable case. The meter, may be read at any desired interval of time, by an official of each—the Local Authority and the Gas Company from whom the supply is procured. In this case, the lighting, cleaning, &c., may be done by the Authority.

From Mr. Meade's figures, the cost of lighting by the meter system appears to be decidedly cheaper than the system of paying at the rate of per lamp per annum.

The average of five large London parishes shows a consumption of 4·46 cubic feet per hour, number of hours burning 3832 per annum, cost of gas per lamp per annum 2*l.* 13*s.* 7*d.*, and lighting, &c., 1*l.* 1*s.* 2*d.*: total 3*l.* 14*s.* 9*d.*; the price of gas was 3*s.* 2*d.* per 1000 feet.

The price paid to the Gas Light and Coke Company by the Hornsey Local Board for lighting was 4*l.* 6*s.* 10*d.* per lamp, but with meters and a consumption of 4·6 feet per hour the Company revised their charges, the amended cost being 3*l.* 12*s.* 5*d.* per lamp; at Wimbledon therefore, basing the consumption at 3832 hours × 4·6 feet × 3*s.* 6*d.* per 1000 feet, the price per lamp for gas would be 3*l.* 1*s.* 8*d.*, lighting 1*l.*, total 4*l.* 1*s.* 8*d.*

SANITARY GAS-MAKING.

By J. ALFRED WANKLYN.

That there are parts of the process of gas-making which are peculiarly disgusting has been popularly recognised from the commencement of gas-making at the beginning of the century. That, in consequence of the nuisance which arises from it, a gas-works has to be banished as far as possible from human habitations is generally taken for granted. That gas itself is foul-smelling, is likewise matter of common knowledge. And lurking behind all this, there is a widespread belief that the gas industry itself is destined to be abandoned as civilisation advances.

Up to the year 1882 very little had been done in the way of rendering the gas manufacture cleanly. It is true, indeed, that attention had been directed to the presence of sulphuret of carbon in gas, and that partial removal of the sulphuret had been effected: but in removing that impurity from the gas there had been an addition to the nuisance of the gasworks itself. And, in the gas industry, a sort of see-saw had been established.

When complaints are made as to the offensive condition of a gas-works, the plea is set up that the offensiveness of the works ought to be regarded as the measure of the purity of the gas.

In the year 1882, it was shown to be practicable to have pure gas and cleanly gasworks at one and the same time, and 1883 marks a new era in gas-making. The process whereby this has been effected is the Cooper Coal-liming Process. In October 1883 this process was introduced into the Tunbridge Wells Gasworks, and from that date onwards Tunbridge Wells has had the advantage of pure gas and an inoffensive gasworks.

The coal-liming process has been frequently described and much discussed since its inception in 1882. It consists in substituting a prepared coal for the unprepared coal ordinarily employed in the manufacture of gas. The preparation of the coal is the admixture of a small proportion of slaked lime, and the result is that a gas which is initially purer than ordinary crude gas is at once produced. In dealing with this new gas there is no need to make foul lime and foul oxide of iron. At Tunbridge Wells, up to October 1882, immense quantities of foul material (oxide of iron and foul lime) were produced in the gasworks and allowed to pollute the atmosphere of the beautiful valley in which the gasworks is situated. The total quantity of foul lime and foul oxide of iron annually discharged by these gasworks was 600 tons in 20 batches of 30 tons each.

Since the establishment of Cooper's coal-liming the production of foul lime and foul oxide in the process of gas purification has been stopped, and the relief thereby afforded has been most strikingly manifested.

So long as gasworks laboured under the incubus of foul lime and foul oxide, no encouragement was given to minor improvement with a view to the diminution of minor nuisance: but now, under the altered state of things arising from the adoption of coal-liming, it has become worth while to look into minor nuisances in gasworks.

Those who are familiar with the ordinary routine in gasworks will know that at short intervals the chimneys of the gasworks begin to emit a little yellow smoke. This arises from the burning of small quantities of tar in the retort-house. The present construction of the gas-retort with its ascension-pipe is responsible for the collection of a portion of the tar round the interior of the mouthpiece. When the retort is opened in order to withdraw the coke, the tar adhering about the mouthpiece is partly burned and partly mixed with the coke, which is thereby rendered dirty.

This condition of things would be remedied by making a change which I believe would be quite practicable. The ascension-pipe should be made to pass out from the bottom or side of the mouthpiece, and should descend to the hydraulic main. This alteration would involve placing the hydraulic main beneath the floor of the retort-house instead of above the retorts as at present. Opposition from the obstructionists in the gas industry would greet a proposal of this description, but I can see no valid reason against it, and I trust that the community will not fail to enforce the obligation of carrying on gas-making operations without nuisance.

Apart from the traces of tar which are occasionally burnt, as just described, gasworks are very happily circumstanced in the matter of fuel. They burn coke (and sometimes gas), that is to say, they burn smokeless fuel. In this respect gasworks compare very favourably with cotton-mills in the north of England.

In many gasworks, as at present conducted, nuisance is occasioned by the gas liquor which is allowed to leak into the ground and to evaporate into the air. Gas liquor consists of a solution of carbonate of ammonia, sulphuret of ammonium, and other ammoniacal compounds. It is very offensive. Being worth from 1*d.* to ½*d.* per gallon, its value might be supposed to ensure its being carefully preserved from leakage and loss by evaporation. Gas manufacturers are slow to change; and the bad habits which date from the time when gas liquor had no commercial value, persist in many works even to the present day. Owing to the leakage of gas liquor, the wells in the vicinity of gasworks have been found to be fouled with ammoniacal liquor. In my own experience as an analytical chemist I have met with examples in point. It is hardly necessary that I should explain to engineers that nuisance arising from the leakage of ammoniacal liquor, or nuisance arising from the evaporation of ammoniacal liquor, is nuisance which is avoidable.

In conclusion I have to say that all the nuisances which arise from gasworks are avoidable, even as the liquor-nuisance. There is nothing in the operation of gas-making which *necessarily* entails the creation of nuisance.

A gasworks ought to be as cleanly as a waterworks, and indeed ought to exert a distinctly sanitary influence.

DISCUSSION.

The **President**: I have great pleasure in proposing a vote of thanks to Mr. W. Santo Crimp, and also to Professor A. Wanklyn, for preparing and reading the papers you have just heard. Mr. Santo Crimp's paper is full of statistical information, and will be extremely useful for reference; whilst the eminence of Professor Wanklyn on the subject of gas-making, endows the paper he has read with great importance: his name has long been associated with this process, and I wish we were convinced, by olfactory demonstration, that the process had been generally adopted, and that gasworks have ceased to be a nuisance. There is still considerable room for improvement. In the concluding part of his paper, Professor Wanklyn says, "Gasworks ought to be as cleanly as waterworks, and indeed ought to exert a distinctly sanitary influence." That reminds me of the belief, which is very prevalent in some parts, that the smell of gasworks has a decidedly beneficial effect upon people with weak lungs, and delicate children are taken and kept in the neighbourhood of gasworks for days in succession; but I never heard that gasworks exerted a sanitary influence in any other way. I have very great pleasure in proposing a vote of thanks to the gentlemen I have named.

Mr. **White**: I have very great pleasure, Mr. President, in seconding that vote of thanks. You have expressed so well what I am sure is the general feeling of the meeting towards these gentlemen who have read the papers, that it is unnecessary for me to do more than to formally second the proposition.

Mr. J. **Lemon**: There is one point I should like to refer to in the first paper, read by Mr. Crimp, as to lighting lamps with oil. It seems to me that the Local Authority at Wimbledon adopted oil-lamps as a means of putting pressure on the gas company, rather than from any advantages which the system itself possessed. The same thing was done in Winchester, and oil-lamps were used there because the Local Authority could not come to terms with the gas company. In the town with which I am more directly connected, we had a difference with the gas company as to the price to be paid per lamp. We used to pay 3*l.* 10*s.* or 3*l.* 15*s.* per lamp, but as the price of gas was reduced we thought we should have a corresponding reduction. Somehow or other, however, the gas company did not see the matter in the same light that we did. Then we determined to take gas for the public lamps by meter. We did so, and put up meters to about every ten lamps. The result was that we saved 400*l.* the first year, which was, as nearly as possible, the price of the meters. The company after this made a still further considerable reduction in the price of gas, and, of course, as the price of gas went down, we got the benefit of it. One of the results was that, as we began to get gas cheaper, we began to want and use more of it. I think that was one of the best features. Now we have some first-class lamps, and the town is better lighted than ever it was before. This is the direct outcome of cheap gas. The introduction of electric lighting has caused almost a revolution in gas-lighting, Gas-lighting, indeed, now competes successfully with electric lighting. Many of you have, doubtless, seen the great improvements made in gas-lighting, and the extraordinary advantages which have resulted from this competition with the electric light. With reference to Professor Wanklyn's paper, I must confess that, until I heard it read, I was under the impression gasworks were not a nuisance. I do not know where gasworks are particularly a nuisance. I know they are put in rather nice parts of some towns, and in others they are placed as much out of sight as possible. Still I know of gasworks in this country, which I am in the habit of visiting, where I never could discover any nuisance. The worst nuisance I ever could detect, in connection with gasworks, was the cartage of the foul lime through the streets; but, now there is the more general adoption of oxide of iron in the purification of gas, I do not think this objection is so strong as it used to be. I am bound to say that gas managers and manufacturers have made great improvements in the management of their works, and show a more earnest desire to carry them on with as little nuisance as possible. During the whole of the time I was in office at Southampton, I never received a single complaint of the gasworks; and I think this is very strong testimony as to the efficient way in which the managers of the gasworks superintend the process of gas-making.

Mr. **Strachan** (Chelsea): With reference to Mr. Crimp's paper on street lighting, I may say that I lived for two years at Wimbledon, and had opportunities of seeing the way in which it was lighted. As a surveyor, I admired the plucky manner in which the people put up with the inconvenience of oil-lamps, in order to bring the gas company to terms. It was a thing they deserved credit for, and it was, to a certain extent, successful; but candour compels me to say it was not the success that gas is, and I do not for a moment think that Mr. Crimp will contend that it was. There is one of the lamps on the table, and you can see by the shape of it, there will be some 16 feet square, directly under the lamp-post, which would be absolutely dark. It used to be a common remark at Wimbledon that, on a very dark night, you could see one lamp from the next. That will give you some idea of the quality and quantity of the light supplied. However, it was a very plucky attempt on the part of the Board to cope with the gas company, and I am glad to see that they are holding out. With reference to the meter system, we manage much better than that in Chelsea. We get every advantage of the lowering of the price of gas, in this way: the company undertake to supply the light a certain number of hours in the year; to put up all the burners required, to consume at a certain rate; and we pay for the cubic feet of gas burnt, calculated at the rate at which each burner was to consume, for the number of hours it is alight. Thus we obtain, without meters, the advantage of every reduction in the price of gas. The directors of gas companies in London are so alive to the progress of electric lighting, that they would rather supply the public lamps at a lower rate than their charges to the general public. With reference to Professor Wanklyn's paper, Mr. Lemon must be exceedingly fortunate in having gasworks which do not cause any nuisance. I unfortunately live near to large gasworks at Chelsea, which have been held up as a sort of perfect model; and I believe the Local Government Board regard them as works where as little nuisance is caused as is possible. I live about a quarter of a mile away, and I can assure you I find the works a great nuisance. Sewage works are sweet compared with the smells from these model gasworks. I wrote to the company complaining of the nuisance, and they invited me to go and see the scientific way in which the purifying process is conducted. I went and saw the works, and then, for the first time, I appreciated the feelings of those persons who used to visit sewage works of which I had the management, when I used to go round with them and show them how scientifically it was all done. The manager of the Chelsea Gasworks showed me the whole process, and asked me if I could suggest anything else, and for the life of me I could not, and he said, "Then the nuisance you have, you will have to put up with."

I may mention the fact (which is very interesting), that the Gas Light and Coke Company—by far the largest gas corporation in the kingdom—many years ago applied to Parliament to relieve them from the necessity of using lime purifiers, because of the nuisance; they brought evidence from miles all round their works to prove that, in certain states of the atmosphere, the smell from the lime process was very offensive. Some of the Members of the Parliamentary Committee visited the Fulham Gasworks (to which I am alluding), and said that, if the process could be conducted with so slight a nuisance, and with such care as was being exercised, they would not interfere, or prosecute the company for a nuisance. I shall take great care to send the gas company Professor Wanklyn's paper, and I hope they will adopt his process.

Mr. White: I am very glad that I do not, like some previous speakers, come from a town where the local authority has been compelled to adopt the desperate expedient of lighting by oil, in order to bring the local gas company to its senses. I have not much information to contribute on this subject, but I should like to mention one matter, bearing on the statistical side of the question, which may be of some little interest, as showing what may be done by good management of the gasworks in a district far removed from the coal-fields. At Oxford the price of gas to private consumers is 2*s.* 8*d.* per 1000 feet, and the price to the Local Authority is 2*s.* 6*d.* The cost of lighting the public lamps, including cleaning, maintaining, and incidental expenses, is 2*l.* 10*s.* per lamp per annum. This, I think it must be admitted, shows what can be done by good management. With regard to the sanitary gas-making side of the question, my experience of gasworks generally leads me to think that the coal-liming process which has been mentioned is not generally used, but that it may with very great advantage be introduced, for I cannot say that gasworks are by any means free from nuisance. The lamps are lighted all night all the year round, and the minimum quantity each lamp should consume is 4 cubic feet per hour; but when tested they have generally been found to average about 4½ cubic feet per hour. The prescribed illuminating power is 16 candles, and the periodical tests show an excess of power. The lamps are lighted 3938 hours per annum. Of the 2*l.* 10*s.* per lamp paid by the Local Board, 2*l.* is calculated to be for gas, and 10*s.* for lighting, cleaning, &c.

A Member: Do you light from sunset to sunrise?

Mr. White: I think that is practically the case. The price I have named includes maintenance—everything except the erection of the columns—even the painting of them is included.

Mr. GODFREY: This is a question my district has felt a great interest in, and has had a great deal to do with, because of the action taken by the people of Birmingham. We have 700 lamps, and have been paying householders' price for gas. In consequence of certain agitation that has taken place, the Corporation of Birmingham decided last February to offer to the different lighting authorities outside the borough, of which my authority is one, that if they would undertake to light, extinguish, clean, and repair the lamps, and adopt the average meter system, the Birmingham Corporation would supply gas at cost price. This was a reduction from 2*s.* 1*d.* per 1000 feet to consumers using more than 20,000 feet per quarter to 1*s.* per 1000 feet. I commence next Wednesday, July 1st, to light nearly 700 lamps at 1*s.* per 1000 feet of gas. This, the Birmingham Corporation say, is cost price, and that they can manufacture gas at 1*s.* per 1000 cubic feet. We have put down meters—about one to every ten or twelve lamps; not a hard-and-fast line of a meter to every twelve lamps, but at different points of elevation, according to the contour of the district. The difference between 2*s.* 1*d.* and 1*s.* means in my district alone a reduction of 570*l.* a year, which we have been paying for years past towards reducing the rates of Birmingham. I contend, and contend very strongly, that the only way municipal engineers and sanitary surveyors can advise their boards to deal with gas companies is, to adopt the average meter lighting system. The lighting should be in the hands of the local authority, and they should not be tied or bound by any agreement in any shape or form to the gas company, except to pay a certain price per 1000 feet for the gas they use; and they should light and extinguish the lamps themselves. If a company of private speculators could get a subvention from the rates (and it was nothing less if at Wimbledon the Local Authority was paying 3*s.* 6*d.* per 1000 feet for gas), the ratepayers really put money into the pockets of a private company; and this, to my mind, is wrong in principle. The cost of lighting, extinguishing, cleaning, and repairing, as given in Mr. Crimp's paper, is, I think, rather excessive. I do not know whether I caught Mr. White's figures correctly; but at King's Norton we, as an outside authority, have been paying the Birmingham Corporation 13*s.* per lamp for lighting, extinguishing, and cleaning, and repairs to the lantern; and I am told that in one district this was done for 12*s*. 6*d*. per lamp. The average meter system is the only way by which you pay for what you get, and no more. As to paying 4*l*. 10*s*. per lamp, that is simply preposterous; and I think the Wimbledon Board are deserving of every encouragement in their opposition to what I regard as an attempt at extortion, which the gas company there is carrying on. At King's Norton we are paying 1*l*. 12*s*. 10*d*. per lamp, burning 3960 hours per annum, 17-candle gas at the rate of 4 cubic feet per hour; and we are now going to have it reduced from 2*s*. 1*d*. to 1*s*. per 1000 cubic feet. I think that gas corporations and gas companies generally do not reduce the price of gas to public bodies as they ought to do.

Mr. Ellice-Clark: One is very glad to see that town surveyors are endorsing the opinions of the Members of this Association as to the value of adopting the average meter system for indicating the consumption of gas in public lamps, recorded as far back as May 1875. In volume ii. of the 'Proceedings' will be found a paper on the subject, giving full details of the method adopted in that year by the speaker at Ramsgate. The system was first put into operation by Messrs. Hawkesley at Nottingham. It might be worth while recording that at Hove, where there are 700 lamps, the average meter system of one meter to fifteen lamps is adopted in half the area of the town, and the positive meter, viz. one to each lamp, in the remaining area, the result, after seven years' experience, showing that there is no substantial difference in the indicated quantity consumed, and that for all practical purposes one meter to fifteen lamps is sufficient. The attempt to determine the quantity of gas consumed by regulators only had been tried by the speaker and abandoned; the regulator being an indispensable adjunct to the average meter system, but an unreliable recording instrument in itself. Surveyors not having adopted a system of meterage would do well to study the paper referred to in volume ii., p. 183.

Mr. E. Buckham: The use of the average meter system must be adopted with caution, because my slight experience in public lighting has been this: if you use gas equal to 5 cubic feet per hour per lamp, then the average meter system would be beneficial to the corporation; but, if you only burn 3½ feet per hour per lamp, then I believe the system will tell against the corporation. I do not know whether other Members of the Association have come to the same conclusion, but this has been my experience.

A **Member**: Are you speaking of gas supplied to private consumers?

Mr. **Buckham**: I am speaking of gas supplied to all public lamps, where, as at Ipswich, the consumption is 3½ cubic feet per hour per lamp; and I believe we are better off without the average meter system than we should be with it. But, if we burnt 5 cubic feet per hour, then I think it would be to our advantage to have the average meter system. Now that I am speaking, I should like to submit another matter to this Association. We have had a new street made up in our borough, and when we applied to the gas company to put in gas mains, and provide lamps for lighting it, the company objected, and wanted the Corporation to pay for the main. It appears that, under their Act of Parliament, if the corporation want a lamp lighted within 80 yards of an existing main, the company must supply the gas. There was only one lamp in this street, but it turned out that it was supplied from a service pipe, and that there was no main within the prescribed distance. As we could not get over this difficulty, we adopted oil-lamps, and they answered our purpose very well for a while, and resulted in bringing the gas company round, and they ultimately laid the main. My object in mentioning this is to ascertain how other surveyors stand in respect to laying gas-mains in new streets that are made up—whether they contribute anything towards the cost, or whether the gas company are bound to lay the main?

The **President**: what do you mean by a "new street made up"?

Mr. **Buckham**: I mean a street made, paved, channelled, and dedicated to the public, under the 150th section of the Public Health Act. As to gasworks being a nuisance, all depends on circumstances. I know where gasworks are a nuisance, and where they are not. In some towns they are a great nuisance, and in other towns they are no nuisance whatever. At Ipswich the gasworks often cause a nuisance; but I was for a few years at Maidstone, where the gasworks were extremely well conducted, and I never experienced any nuisance there that could be complained about.

Mr. **Dunscombe**: I think the experiment made with electric lighting at Wimbledon is satisfactory, so far as it goes; but there are one or two points on which I should like information. No explanation has been given why the experiment was of such short duration, or what was the reason why it was abandoned? The results given are certainly very satisfactory. I have recently had occasion to go into this question on a very large scale, and my inquiries resulted in this—that taking the full hours a street lamp ought to burn (from 3600 to 4000 hours per annum, according to the number of hours adopted), only under the best possible conditions, and with continuous lighting for the number of hours named, can we in any degree with incandescent lamps approach the price of gas. Under the best conditions, with incandescent lamps of 20 candle-power burning continuously for 3600 or 4000 hours per annum, with a very extensive installation, probably amounting to several thousand lamps, and dealing with a very large area, it might be possible to bring down the cost of each lamp to ¼*d.* per hour. But this is a result which has not yet been attained. In the case of Wimbledon, I find that, in the short experiment of eight weeks, the cost came out only about ½*d.* per hour, and I should be glad, therefore, to know the cause of the electric lighting being abandoned when it yielded such very satisfactory results. Electric lighting, as most people are aware, cannot, at the present time, compete successfully with gas. It has made immense strides, and will no doubt continue to do so; but assuming that the cost of gas and electricity were equal, I fail to see what benefit would accrue from the adoption of incandescent lamps for street lighting in the place of gas. For internal lighting and for house lighting, electricity has many good features, but for street lighting I fail to see the advantage of it. I think it has certainly done this amount of good—it has directed the attention of gas engineers to the necessity of improvement; and with gas supplied, as it now is in most towns, at a very low price, I think the proper course for people now to adopt is, to turn their attention rather to the wasteful consumption of gas which obtains in many instances, and to the bad fittings which are used in others, and to effect improvements there. Street lighting by gas has been considerably improved, and with proper fittings, proper burners and regulators, and carefully designed lamps for the candle-power requisite, I think there is nothing required but what may be obtained from gas. I must say I do not agree with some of the speakers as to the advantage of the average meter system. I do not think it is worth the expense, because it will be found in practice that, if due care is exercised with regard to the burners, and providing approved regulators, the supply can be regulated within 1 or 2 per cent. of the average meter indications. The cost of supervision and of laying down the necessary plant is considerably more than any board can save in lessened consumption of gas by the average meter system. I speak from some experience in Liverpool, where I have at present 12,000 lamps to light; and the cost of these lamps per annum is 2*l.* 17*s.* 1*d.* each, burning about 3800 hours. The price of gas is 2*s.* 9*d.* per 1000 cubic feet. The course adopted by the gas company is to simply use the Borrowdale regulator, and the result of their experience tends to show that the gas they lose is very slight, because we pay for a certain estimated consumption of gas. We pay for 4 feet of gas per hour, burning a certain number of hours, and if the lamps did not yield a light equal to 16 candles we should ascertain it at once; but I have never yet had occasion to remonstrate with the gas company that the lamps were not giving the correct amount of light. For internal lighting and lighting large open areas, both incandescent lamps and arc lighting, under varying conditions, are very valuable; and on the whole, though electric lighting for such purposes will no doubt make great strides in the future, as it has done in the past, I do not think for street lighting pure and simple, apart from the question of instantaneous lighting and extinguishing, there is any benefit to be gained by electricity, even if the time should arrive when the electric light can be produced at almost the same cost as gas.

Mr. R. P. SPICE: I have not any data on which I could speak with regard to the details of the paper read by Professor Wanklyn, but I have found myself, after forty years' experience in the manufacture of gas, and the business of gas-lighting, in all parts of the United Kingdom, a very staunch advocate, although the only one, I believe, in the profession, of the process of manufacturing gas from limed coal. I have had nearly two years' experience of this process on a tolerably large scale, involving the carbonisation of between 11,000 and 12,000 tons of coal per annum. There has not been any supplementary work done for the manufacture of gas at Tunbridge Wells, where all this work has been effected by this process. We are not obliged by Act of Parliament to take out what are called the sulphur compounds, about which a great deal has been said and a great deal has been done. A vast amount in the way of contention and litigation has taken place during the last ten years with regard to these sulphur compounds; which were not thought of twenty years ago, even in the City of London, which is supposed to be the "hub of the universe" with respect to gas-making. But they are unquestionably a great nuisance, and when gas is consumed in an ordinary close apartment, if it contains as much as 30 grains of sulphur per 100 cubic feet of gas, it will be found very objectionable so far as the lungs and sensitive organs of the human frame are concerned. Some men, I know, will "pooh-pooh" that statement, and say they do not care for a few grains, even 30 or 40 grains; and I may say that as much as 40 grains of sulphur compounds are to be found in the gas produced at Manchester. With the ordinary run of Newcastle coal, when gas is manufactured by the ordinary process of oxide of iron purification, there will be, on the average, not less than 30 grains of sulphur compounds per 100 cubic feet of gas. Now, modern legislation has for several years prohibited—and there have been about thirty or forty Acts of Parliament passed on the subject—more than 20 grains of sulphur per 100 cubic feet; and in order to ensure escaping the penalty if the quantity exceeds this limit, the works must be managed so as not to produce more than 14 grains. They must have a safe margin, because it cannot be calculated to a nicety in manufacturing gas. This has involved the creation of another nuisance. The removal of these sulphur compounds has necessitated the use of lime in the purifier, in a certain state. The lime in this state is called sulphuret of calcium, and is the first of a series of purifiers. When the lime in the first purifier has arrived at that stage (before which it could not be effective, and after which it would cease to be sufficiently effective) these sulphur compounds can be brought down to something like 8 grains per 100 cubic feet, but the removal of the lime unquestionably causes a nuisance of an intolerable character in the immediate vicinity of the gasworks; and it is not confined to the vicinity of the works, for when the lime is removed, the vapour from it, containing this horrible stench, would be wafted by the wind in whatever direction it might be blowing, and within half a mile, or it may be a mile of the gasworks, this anything but delightful smell will make its presence felt. This is a nuisance which I have been in the habit of considering almost a greater nuisance than the presence of the sulphur compounds themselves; but seeing that there is no nuisance created by the removal of these compounds by using 2½ per cent. of lime mixed with the coal in the retort, I hold it to be unpardonable that any gas company should continue either to leave the sulphur compounds in the gas, or to take them out by the sulphide of calcium process. At Tunbridge Wells, the gas is made well within the requirements of the Metropolitan Gas Referees—17½ grains in summer, and not exceeding 20 grains in winter; and we have no difficulty whatever in manufacturing gas of this degree of purity. Financially, the result of the process has been an important addition to the profits of the gas company. I have come to this conclusion, after very careful calculation, that if the process were applied to all the gas manufactories in London, the saving to consumers—because it comes to this, since, if a gas company can make gas cheaper, they can sell it cheaper and make the same dividend—on the gas made at the present time would approximate to 200,000*l.* per annum. I stake my reputation on that statement, and what is more I am prepared to prove it if I only have the opportunity, which I hope I shall have. I would only add that, at Tunbridge Wells, the process has been uninterruptedly in operation for nineteen months—including this, twenty months—and during that time we have only opened one purifier once (although we have only one purifier instead of six), and that for a purely mechanical reason.

Mr. GAMBLE: Does the process remove the pungent smell from the gas, when it escapes from the mains in the streets, with which we are so often troubled?

Professor WANKLYN: I can answer that question. The gas prepared from limed coal has the smell of pure benzol; and is entirely devoid of the ordinary stink associated with gas. Very early in the history of the coal-lime process a quantity of gas was prepared, and I placed my head in a large stream of it issuing from a gas-holder; and I was struck by there being only the simple smell of benzol, and by the entire absence of a number of miscellaneous stinking compounds which give the smell that used to be associated with gas.

Mr. DUNSCOMBE: To what degree are the sulphur compounds eliminated?

Mr. GLEDHILL: How is the lime mixed with the coal?

Mr. GORDON: This is a very important question which has been brought before us, and I have listened to the papers with great interest. My Corporation own the gasworks at Leicester, and of course they are necessarily extensive. Therefore we are somewhat in a different position, with regard to street lighting, to many corporations and local boards which do not possess gasworks of their own. I am bound to say that, so far as I have had an opportunity of observing the manufacture of gas in Leicester, the Corporation are exceedingly desirous to have it manufactured in such a way as not to be any nuisance; but I cannot bear out the statements made by some speakers this afternoon, that there is really no nuisance. Mr. Spice told us distinctly that the extreme desire to purify the gas creates another nuisance, and, he thinks, a greater one. Therefore I should have hoped that all gas managers would have hailed, with a great deal of satisfaction, this new process, if it possesses all the advantages claimed for it, and would have desired to follow in the steps of those who had made the experiments at Tunbridge Wells, which, according to what has been laid before us, seem to have solved the difficulty of purifying gas without creating a nuisance. I hope Professor Wanklyn will tell us whether Tunbridge Wells is the only place where this process is in use at the present time; and also, if he can, tell us the reasons why it may be supposed other corporations and gas companies have not adopted it. We have heard from Mr. Spice that the cost of the lime coal process is less than that of any other. If that be so, it seems still more strange that it is not generally adopted by gas companies, and this fact alone would seem to point to some doubt or disadvantages we have not been made acquainted with. There is another point on which I should like Professor Wanklyn to give us some information. Does the lime coal process affect the value of the residuals? If it does not, then it appears to me extraordinary that there should be any reluctance or unwillingness on the part of gas managers and gas companies to adopt the process. Some remarks have been made this afternoon with respect to gas companies, which, I think, go a little further than is justifiable. Gas companies do not desire, as a rule, I take it, to extort anything from corporations or local authorities. I think the more rational view is that, as a rule, it is the fault of the corporation if they allow companies to be formed for street lighting purposes. When companies seek to light a town, just as when companies desire to provide a good supply of pure water, they are hailed as great benefactors; but I think they are undertaking a duty which should be discharged by the corporate body. Therefore we should not be too hard on the companies, because, whilst there may be an instance of one very lucky local board in the vicinity of Birmingham getting its gas at cost price, I take it that is a thing which will not be met with again. Surely we cannot expect companies to run the risk of establishing costly works, and investing a large amount of capital, to supply us with gas at cost price, or at merely a nominal profit. The very object of establishing such a company is to realise a profit; and it would be a very bad precedent for corporations which own gasworks, to set to supplying other lighting authorities with gas at cost price. There are large suburbs rising up around populous towns, which cannot see their way to establish works of their own, and therefore must necessarily be supplied with gas by the larger community. But the larger community cannot be expected, at the expense of the ratepayers in the borough, to supply the outlying districts at cost price, as is being done at Birmingham. There is also another question which would interest me, if Professor Wanklyn would be kind enough to answer it. It is, whether it is quite correct to say that the chemical works generally associated with gasworks, for the manufacture of residual products into chemicals of greater marketable value, can be carried on perfectly free from any nuisance? This is very important, because gas companies, as well as corporations who own gasworks, very largely dealt with these residuals in the way described, rather than sell them to chemical companies. Though by the process described, we might be going in the right direction to get pure gas without any nuisance, we should also be satisfied that, in dealing with the residuals, we do not create a nuisance of another kind.

Professor **WANKLYN**: The lime is mixed with the coal in this way:—The lime is slacked with about its own weight of water, and then it is thrown upon the coal and left to mix itself with the coal. Where there is a West machine on the works, the machine is used; but you can get very good results by merely throwing the slacked lime upon the coal, and allowing it to mix itself. It costs ½*d.* per ton to mix the lime with the coal. Then, as to the extent to which the sulphur compounds are reducible by this process. Two or three days ago, I obtained from Tunbridge Wells the returns for the last six months. There is an official tester at Tunbridge Wells, who does his work in a very careful manner, and for the last six months his return is that the average has been 12·8 grains per 100 cubic feet of gas. When we choose, we can reduce the sulphur compounds to 3 or 4 grains per 100 cubic feet. At Tunbridge Wells we are not aiming, at the present time, to reduce these sulphur compounds to the lowest possible figure; but we reduce them to the figure to which they are reduced by good gas companies which make foul lime—12 to 14 grains per 100 cubic feet. We do the same thing without making any foul lime. As to the question of the residuals, there is a great increase in the ammonia. At Tunbridge Wells we have gained 30 per cent. more ammonia, and the total financial result is a yield of at least 1*s.* per ton of coal carbonised extra profit. This is shown by twenty months' working, and can be verified by the official figures. My own belief is, that, with careful working, the financial results would be even better than those stated. I have very great difficulty in hinting to you the reasons why the process is not generally adopted; but I should recommend those who would like to know the reason to read the history of gas-making. Any one who makes a small improvement can readily get it adopted; any one could get in a new washer; but any one who effected a really great improvement will be persecuted. It will take years to get this improved process adopted; and the greatest difficulty we shall have with this process is, that it is a monetary success. If it cost something substantial to adopt the process; if it involved expensive apparatus, we should have less difficulty in getting it adopted than we have now; because it is comparatively inexpensive, and is a financial success. I speak this deliberately, and I believe it.

Mr. Cooper (who represented Mr. Crimp): It certainly was to put pressure on the local gas company that oil-lamps were adopted at Wimbledon. The opaque bottom of the lamp is a disadvantage, but I do not think the shadow cast is so great as 16 feet, as stated by Mr. Strachan. We are now adopting glass holders for the oil, which will decrease the shadow. I think the figure (4*l.* 10*s.*) as to the cost of gas-lighting given in the paper is correct. I have run the figures out for a lamp burning 4000 hours per annum, and consuming 5 cubic feet per hour of gas at 3*s.* 6*d.* per 1000, and the cost would be about 3*l.* 10*s.* per lamp. Then there has to be added to that, labour and repairs, which brings the cost up to about 4*l.* 10*s.* The repairs in the case of lighting by oil come to a considerable sum, on account of the doors having to be opened every time the lamps are used, and consequently there are more breakages. Mr. Godfrey has named 13*s.* per annum for lighting, extinguishing, cleaning, and repairs. That might be all very well for lighting new lanterns, but we had a lot of old ones, and the labour connected with lighting with oil is very much greater than with gas. In the case of lighting with oil, men have to go round three times in the day, whereas with gas they have only to go round twice, except when they clean the lamps. Mr. Buckham had asked a question respecting paying gas companies for laying mains in new streets. We have experienced the same difficulty at Wimbledon, as the gas company very often refuse to put down mains, especially for private inhabitants. Mr. Dunscombe asked why we discontinued the electric light, when it had yielded such good results; I think the experiment was discontinued quite as much on account of the failure of the contractor as anything else. The electric light has a very great advantage over gas for street lighting, because you can light all your lamps from one station, and have not to send men round to light and to extinguish them; and if the moon happens to be bright, you can turn off the electricity and store it up, and you have not to cut your streets about to lay and repair gas-mains.

Comparison of the Number of Hour-Candle-Powers of Light Produced for 1*d.* by the Following Means of Lighting.

	Hour-Candle-Powers.
1. Rettich's mitrailleuse, 16 wicks, nominal 40 candle, 35 actual, consuming 1 quart of oil (at 7½*d.* per gallon) in 13 hours, produces with 1*d.* worth of oil (labour and depreciation not included)	248
2. The ordinary 1⅜-inch flat-wick oil-lamp, consuming 1 pint in 14 hours and giving 12 candle power, produces with 1*d.* worth of oil (labour and depreciation not included)	168
3. Gas at 3*s.* 6*d.* per 1000 cubic feet produces, with 1*d.* worth of gas (labour and depreciation not included)	100
4. Electric light at ¼*d.* per hour for a 10 candle power, produces (everything included) for 1*d.*	40

HIGHGATE HILL TRAMWAY.

BY T. DE COURCY MEADE, A. M. INST. C.E., SURVEYOR TO THE LOCAL BOARD, HORNSEY.

THE Highgate Hill Steep Grade Tramway was authorised by a Provisional Order which received the sanction of Parliament in 1882.

The works were commenced in November 1883, by the Patent Cable Tramways Corporation under the supervision of Messrs. Eppelsheimer and Colam, Civil Engineers, and the line was opened for traffic on the 29th May, 1884, by the Right Hon. the Lord Mayor, M.P.

The tramway commences near the Archway Tavern, at the foot of Highgate Hill, and terminates at the top of the hill near Southwood Lane. The total length of route is nearly ¾ mile, of which about 1100 yards is a double line, the remainder—owing to the narrowness of the road—being a single line, with passing-loops. The gradients vary from 1 in 11 to 1 in 15 on the lower part of the road, but at the top of the hill the roadway is, for a short distance, practically level. The line is laid on the 3 foot 6 inch gauge, and, externally, has the appearance of an ordinary tramway, with the addition of a centre groove or slot, which runs throughout the entire length of each track. The slot is formed with two Z-shaped rolled steel girders weighing 36 lb. per yard, supported by transverse castings at every 3 feet 6 inches. The space between the upper flanges of the girders is ⅝ of an inch. Through this groove or slot the shaft of the "gripper" passes down to the cable, which is carried on pulleys in a tube beneath the track. The tube is formed of concrete, composed of 1 part of Portland cement to 6 parts of Thames ballast, and measures 10½ inches in depth by 8½ inches in width; the bottom of the tube is 17 inches from the surface of the roadway. The rails are of steel of the Dugdale type, weighing 52 lb. per yard. The chairs which carry the rails are bedded in concrete, and are secured by tie-bolts to the transverse castings.

The cable pulleys are placed in pits at intervals of 40 feet apart, except on the curves, where they are placed closer, according to the nature of the curve. The pulleys are 12 inches in diameter, and are secured to cast-iron standards bolted through the side of the concrete tube. The latter are fixed at angles varying to suit the position of the cable, which has to be accurately maintained in order to enable the "gripper" to be freely worked.

The pulley-pits are 6 inches deeper than the tube, and at the bottom of each pit there is a small stoneware gulley in connection with the public sewer. Any sand or drift washed from the road surface into the tube is retained in these gulleys, which are regularly emptied by the Company's employés when lubricating the pulleys, for which purpose Stauffer's patent lubricators are employed. The pulley hatch covers are of cast iron filled in with wood blocks, and measure 18 inches by 11 inches on the surface.

Where the line is double, the endless wire rope travels up one track and down the other, but in the single line the rope is carried on a double set of sheaves, working on the same spindle.

The intersection of the slot at the passing-places is maintained by a very simple arrangement. A bar of spring steel, about 18 inches in length, is bolted to the castings at the intersection of the girders; the gripper shank of each descending car moves this spring aside while passing, which immediately returns to its former position and closes the slot of the down line.

At the ends of the line there are terminal pits containing a series of pulleys 8 feet in diameter, round which the cable passes. In the terminal pit at the bottom of the hill a horizontal tension pulley, with counterweights, is provided, for the purpose of keeping a uniform tension on the cable.

The depot and engine-house, from which the cable is worked, are situated about a quarter of a mile from the top of the hill.

Opposite the engine-house, and connected with it by a subway, is a pit, measuring 16 feet by 5 feet and 7 feet 6 inches deep, containing four deflecting pulleys. By means of these pulleys the cable is passed at right angles to the tube into the building, and thence to the wheels which impart motion to it.

The cable is formed of crucible steel wire, and consists of six strands of 19 wires each, or 114 wires in all, wound round a Manilla rope. The wire is No. 16, B.W.G., is very pliable, and has a tensile strain of about 200,000 lb. per square inch. The diameter of the rope when new is about $\frac{15}{16}$ of an inch. The total length of the cable is about 7850 feet. A rope in the course of its life will stretch about 1 per cent. of its length, therefore, in addition to the tension pulley at the bottom of the hill, a taking-up apparatus is provided at the engine-house, by which means about 100 feet of rope can be taken in without re-splicing. The splice is generally about 30 feet in length, and under ordinary circumstances a new cable could be laid and spliced in about seven hours. In order that any flaw or damage to the cable may be promptly detected, it is made to pass during its course through the engine-house, in view of the person in charge of the engines. The average life of a cable is said to be from twelve to eighteen months, and the cable in use at Highgate is expected to run the full average time.

Considerable difficulty was experienced in obtaining a site for the engine-house and depot, the Company not having power of compulsory purchase. At length a shop and premises in the High Street were secured, which in some respects were most unfavourably circumstanced, having old and not over substantial buildings on either side, the site being composed of soft Bagshot sand for a depth of from 35 to 40 feet, and the level of the path in front being some 2 feet 6 inches above the carriageway.

The engines and boilers are placed in the basement, about 12 feet below the road level. The ground floor is utilised for a car depot, with offices and dwelling-house over. There are two horizontal reversible high-pressure engines, with 14-inch by 28-inch cylinders, fitted with Collmann's automatic expansion gear. A cast-iron pinion on the crank-shaft gears into a cast-iron helical toothed wheel on a countershaft, which also carries the grip pulley—the latter has jaws of an elongated V shape. The average speed of the engines is 72 revolutions per minute, which is sufficient to work the rope at a speed of 6 miles per hour, the maximum rate allowed by the Board of Trade. Owing to the nature of the site and surroundings of the engine-house, it was necessary that vibration should be reduced as much as possible, and apparently this has been successfully accomplished. A large reserve of boiler-power has been provided, there being three 50-H.P. tubular sectional boilers. Steam, it is said, can be got up from cold water in less than forty minutes with these boilers, which is an important consideration where the work is so variable.

The rolling-stock in use is of two kinds, viz. (1) the "dummy" and ordinary car, (2) the bogie car with gripper combined.

The open type of car known as a "dummy" is fitted with gripping arrangements, &c.; to this an ordinary car is attached; both cars are provided with powerful brakes. The dummy carries eighteen passengers and the car thirty-six. Although the dummy is preferred by many passengers in fine weather, it has several drawbacks, one of the chief objections being the necessity for shunting on the completion of each journey. The dummy is therefore about to be superseded by the bogie car, with gripping arrangement at each end.

The slipper brake is used on both descriptions of car, and it does not, as yet, appear to injuriously affect the permanent way.

The "gripper" has been the subject of several patents. That used on the Highgate line consists of a shank of steel 10 inches wide and ½ inch thick, which passes down from the car to the jaws of the gripper. The centre portion of the shank plate (5 inches wide) is fixed, and the outer bars 2½ inches wide actuate the lower jaw by means of a wedge, spindle, and wheel, worked from the car. The jaws are about 12 inches long, and are hollowed on the inner sides to a larger section than the cable. Two grip hatches are provided opposite the depot, through which the gripper is lowered into the tube when the cars are first brought out. While passing the deflection pulleys on the downward journey, the gripper automatically leaves the cable, and the cars descend by gravitation for a few yards, when the gripper again returns to the cable track.

The cost of the construction of the line is given by Mr. Eppelsheimer in the Minutes of the Proceedings of the Institute of Civil Engineers, vol. 79, page 165, as follows, viz.:—

"The line proper, with the paving specified by Act of Parliament, and with five cars and three dummies, had cost, irrespective of land and buildings, 18,111*l.* The engine-house had been very expensively constructed, owing to the requirements of the landlord, and, together with the lease, cost about 6,000*l.* With regard to the wearing of the ropes and pulleys, which had been referred to as serious, his experience in the matter led him to the conclusion that the cost on that head would be about 180*l.* per mile of rope per annum, which he did not think was a high figure, comparing it with the items of cost either in horse- or steam-tramways, for additional wear and tear, and sanding of the tracks."

The line has been working a little over twelve months, during which time there have been two mishaps, and in both cases a searching inquiry was held by Major-General Hutchinson, R.E., representing the Board of Trade, and the following extracts from the latter gentleman's official reports show that the blame lay solely with the Company's servants in each case, there being no mechanical failure whatever.

Extract from Major General Hutchinson's Report, dated 20th September, 1884.

Cause—"was primarily due to the negligence both of the driver and conductor of Dummy No. 6, attached to car No. 3, in failing to have the slipper brake properly coupled to the dummy before starting."

Extract from Major General Hutchinson's Report, dated February, 1885.

"The primary cause of this accident was the breach of Regulation No. 7, which states that 'the carriages shall not be allowed to descend the tramway by gravity alone, but shall always be attached by the gripper to the cable, except when stopping, or passing the spot near the engine-house where the cables cross.'"

The author has had daily opportunity of watching the working of this line, and although he must plead guilty of being at first somewhat sceptical, he is now of opinion that the working of the line has been so far undoubtedly a mechanical success.

In conclusion, the author, while apologising for the imperfect manner in which this paper has been prepared, owing to pressure of business, has to thank Mr. W. N. Colam, C.E., the Engineer to the Highgate Hill Steep Grade Tramway, and the Patent Cable Tramway Corporation, for his courtesy in affording information, and lending explanatory plans, diagrams, &c., for the information of Members of this Association.

DISCUSSION.

Mr. **Colam**, the Engineer of the Tramway Company, explained the plans and diagrams exhibited on the wall. Pointing to a half-size drawing of the cross-section of the track and tube at Highgate, he showed that the rails were of the class generally used for horse-tracks, and were cottered down to cast-iron chairs, which were imbedded in 6 inches of concrete in the ordinary way, so that the only thing in addition was the tube, which was only 8½ inches by 10½ inches deep. Another drawing showed an adaptation of a slot-rail, to meet objections raised at Liverpool, where it was stated there was too much iron in the centre of the track. Assuming the pipes crossing the road not to be nearer the surface than 17 inches, the drawing showed that the tube would in no way interfere with them. He next described a longitudinal section of the tube, the gripper and its action, the pulleys and how they worked, and added that the severest grade is 1 in 11, and the average of the whole line 1 in 16. He then showed and explained a diagram of the slipper-brake—a special one used at Highgate—besides which, ordinary wheel-brakes are fitted to every car. The slipper-brakes, when pressed down upon the rails, take the weight of the car and passengers and are very effective. Experience showed it was possible to work the line with perfect safety. On the steepest inclines there was not the slightest danger, because if both the slipper and the ordinary brakes failed, the gripper still had hold of the rope; indeed it is far the safest motor for public streets.

Mr. Dunscombe: There are one or two points I should like more information upon. I am sure we are all indebted to Mr. De Courcy Meade for the paper he has read describing the Highgate Tramway, which is a matter of interest to us all. But I should like to know whether any particulars have been kept of the cost of working the line per mile run? I see from the paper that, eliminating the cost of the cars and the dummies, the permanent way for a 3-foot 6-inch gauge has cost 10,500*l.* per mile. That strikes me as being more or less a prohibitive price. I have had occasion to go into this question at Liverpool. There was a short length of line which the Corporation desired to lay in William Brown Street on the cable system, where the gradient is about 1 in 14. The result was that I found the cost of constructing this line in a town like Liverpool, taking into consideration all the necessary requirements, would be enormous. This statement is borne out by what Mr. Meade states in his paper has been the cost of the Highgate Hill Line. I have no doubt most of the gentlemen present have inspected that line. I did so myself on many occasions during its construction, and after it was opened, and although fairly well laid, I have no hesitation in saying that the Highgate Hill Line would not be allowed in any town where the vehicular traffic is great. It is perfectly suitable for Highgate Hill; but for any town where vehicular traffic is of the first importance, it could not possibly be allowed to be constructed in the manner in which it is laid down at Highgate Hill. You will see at once the obstacles in the way in such cases. Assuming a double line of tramway, instead of only four lines you have absolutely what you may fairly call six lines to maintain. It is well known that the great cost in connection with the maintenance of tramways consists practically of the maintenance of the setts abutting on the tramway rails; and this is considerably increased in cable lines. It is impossible to pave the tramway track so as to form a vertical joint on either side of the tram-rail, and you will see that at once by looking at the diagram. The centre rail and casting is not vertical, and the cost of maintenance of the setts abutting it would be very great. The cost of the permanent way of an ordinary tramway would be, perhaps, 1500*l*. a mile, and unless there is something to counterbalance the increased cost of the permanent way, from 1500*l*. to 10,000*l*. a mile—in Liverpool it would be 12,000*l* a mile—I fear that the adoption of the cable-line, except in cases such as I have stated, will be very slow in England. I should like to have particulars relative to the cost of working the line, and also to know what saving there is as regards traction towards compensating for this increased expenditure on permanent way.

Mr. Boulnois: There is one point I should like explained. Objections might be raised in many towns that the manholes of the sewers are so arranged that they shall come between the rails of an ordinary tramway. But if we have this additional central rail to contend with, I do not see how we shall get over the difficulty. Another point I should like to know is, how the groove is kept perfectly free of dust? On a hill I can understand this can easily be done by passing water down, but on the level road I should imagine dust must accumulate.

Mr. Fowler: I should like to know how the groove or channel for the rope is kept clear of snow and rain-water in bad weather. In Manchester, tramways have been stopped for a short time during heavy snow-storms; and I should imagine the drier the weather the greater would be the tendency of the snow to drift into these channels. I should like to know whether there has been any heavy snow-storm during the working of the Highgate tramway; and, if so, what was the experience in connection with it. I should also like to know as to the horsepower required per mile of tramway working the line.

Mr. Meade: Mr. Colam has kindly promised to reply to questions as to cost, and also to Mr. Fowler's inquiry respecting snow. Since the line at Highgate has been laid, we have not had a very heavy fall of snow, but the cars on this line were the only ones running during a snow-fall last winter, when all other traffic was for a time stopped; on this occasion the snow reached a depth of 6 inches in places. The accumulation of dust in the tube does not cause any difficulty or annoyance. In very heavy storms some water finds its way through the slot into the tube, when any dust or accumulation that may have taken place previously is washed down to the next gulley, where it is intercepted. These gulleys are cleaned out periodically, and the tube appears to be perfectly clean. The permanent way stands well; it has been opened for traffic over twelve months, the car service being every five minutes. In reply to Mr. Dunscombe I may observe that the paving next the slot irons is at present in excellent condition, and I have noticed no rocking setts.

Mr. Colam: Mr. Dunscombe has said that the cable tramway will not stand very heavy traffic, and that this prohibits its introduction into any large city. Mr. Dunscombe does not give his reasons, excepting that the slot-beam, as shown on the diagram (for Liverpool), is slightly on the incline. Well, my experience is that a drawing will show the slightest deviations, but on the line itself you will find it very difficult to detect. I think we have got a piece of Highgate slot-beam lying on the table, and you will see that is a far worse section, and more difficult to arrange the sett stones against than the one shown on the drawing to which Mr. Dunscombe has alluded. Those who have been to Highgate will agree with me that there are not many lines about London the paving of which looks better. I contend, as the tube frames embedded in the concrete are practically immovable, and as the rails are bolted every 3 feet 6 inches, every stone is perfectly squeezed into its place between the rails and slot-beam, and I do not see how you are going to move these stones at all. That is my experience. I have once or twice had to take up some of these stones, and I know what it means. If any gentleman would like to make the experiment, I shall be very happy to arrange for him to do so. I can assure you it is a matter of squeezing these stones together, and you will find every stone between the slot-beam and the rail is thoroughly pinched, and cannot possibly get out of place. Then Mr. Dunscombe referred to the cost of construction.

With all deference to Mr. Dunscombe, I do not think he has dealt with that question in the proper way. It is no use talking of what a line will cost for construction only. The question is what will the line have cost per mile when ready to run; that is to say, you must include equipment if you wish a fair comparison. If we can show we can make a line which will do all the work you require, at a lower price than you can get it done in any other way, and at the same time we can give better accommodation, I presume such a line is the best. At Highgate, the cost of the line was 18,000*l.*, or about 12,000*l.* per mile of single track. The Highgate line is about one of the worst for testing the cable system, because it is only 6 furlongs in length; you have got your motive power always running, and you have little or no traffic on the hill at all—Highgate is quite a little suburb. If the line were three miles in length, the same engines would do the work, and the working expenses would be little more than at present. The difference in the first cost per mile would be a little more than if equipped for horse or steam, and the difference in coal consumed almost *nil.* This is no mere theory; I can prove that it is a fact from the company's book. Last Whitmonday we carried 7200 passengers; but the week before we only carried 1000 a day, yet the consumption of coal was exactly the same on each occasion. The power consumed with the cable system is in keeping the cable in motion, and the proportion required for the cars is very small. Mr. Dunscombe will allow me to say that, in considering the cost of a tramway, we must take into consideration the cost of equipment. I could show you the figures we have lately got out for working 10 miles of tramway in a large town in the midland counties, and the cost for the same line with horses, including construction and equipment for a five minutes' service. We got out the estimates, in fact, for horses, steam and cable. The figures worked out in this way: the cable would cost per mile, equipment and everything, 10,700*l.*; steam, 9636*l.*, and horses, 8636*l.* You will see there is a difference of 1000*l.* per mile between cable and steam, 2000*l.* per mile between cable and horses. That puts a different complexion upon it altogether from what you might suppose, taking as the basis the cost of the Highgate line. But when a cable tramway is completed, you have a line which will take, not only a five minutes' service, but a minute service, at any particular time of the day that it may happen to be required. There is no other tramway service that can do that without a large and expensive reserve of plant. At Highgate we run up to the end of the hill on Sundays—the only day when there is any traffic—discharge sixty passengers and take sixty passengers in, and leave again in a minute. With horses you would have to change ends, and with steam the engine would have to be shunted; but with the cable we have not to do either. Go at any time and watch it, and then I think you will all be satisfied about the working of the line. Mr. Meade has answered the question about dust. This is best seen from the pulley-holes shown here, which are connected with the sewers by 4-inch pipes, trapped. The dust collects a little of course in the tube itself, but by the slightest rain it is carried away to the sewer. Mr. Fowler, I am very glad to say, put a question about snow. That is a matter we rather pride ourselves upon. In Chicago, where they have, as you know, a very large system of tramways, and which city is a perfect dead-level, they tried steam and horses, but finally reverted to the cable. The cost of working 10 miles of line with horses was 25 cents, but with the cable only 11½ cents. The reason for this extraordinary difference is, that in America they allow you to make trains, and do not confine you to one car; and in some parts of the day, when the traffic is heavy, there may be a train of three or four cars run. With respect to the obstruction of snow, the Chicago line was completed in January 1882, and immediately after it was opened Chicago was visited by a severe snow-storm, which are very much heavier there than in this country, as doubtless many of you know. The whole of the vehicular and tramway traffic in Chicago was stopped except on the cable system, which never lost a single trip. At Chicago, when it is snowing heavily, one car is simply kept running, and that keeps the track perfectly clear. At Highgate we had a fall of 7 inches of snow; lots of traffic attempted to get up the hill, but in the end we had to pull the vehicles. I do not say that this is any test; but at Chicago there was snow 2½ feet deep, which of course offered considerable resistance. Last year, during a very heavy snow-storm there, we had a telegram from the manager at Chicago stating that every railway was stopped, and that trains could not get into or out of the city, and yet the cable tramway kept running without interruption. That, I think, is a pretty conclusive answer to Mr. Fowler's question. Mr. Meade has reminded me that it is extremely difficult to get coal-waggons up Highgate Hill. The coal merchants now bring them to the bottom of the hill, take one horse out and send it to the top, and state that they want the waggon drawn up. A small length of cable is sent down by the next car, and the waggon or cart is hooked on, and up the hill it goes at the rate of 6 miles an hour. We have taken up 6½ tons of coal behind a car, which alone weighs 4½ tons itself, besides the passengers. Not only can we do this, but we can stop on a gradient of 1 in 11 and start again, which is no easy thing to do. Mr. Fowler also asked what horsepower it would take to move one mile of rope. I cannot say that I have worked it out exactly in that way, so much depending upon the arrangement of gear. But I can tell you what the horsepower at Highgate is, for moving about 8000 feet of rope. For overcoming friction and keeping the rope in motion, about 9 horsepower is required.

Mr. Laws: There is the question about the manholes? What would you do where the manholes of the sewers, as is generally the case in England, would come in the way of the centre rail?

Mr. Colam: Of course if we had to lay a cable tramway in a city where that difficulty existed, we should have to make some arrangement with the authorities for diverting the manholes. We should have to get permission from the proper authority to move them on one side, and we should have to bear the expense.

Mr. Laws: Then can you give us any statistics as to the amount of traffic on the Highgate Road.

Mr. Colam: I have not the exact figures of what we have done last year.

Mr. Ellice-Clark: Other than tramway traffic?

Mr. Colam: That is not very great, because of the grade; but I have frequently noticed that, when horses are going up the hill, they take our tram track in preference to the macadam road. We have never heard any complaint of horses slipping, or anything of that sort, although we have a third rail, but it is only half an inch of iron at the surface, and that would hardly be noticed.

Mr. Ellice-Clark: The maintenance cost of a tramway depends very largely upon the number of vehicles passing over the street in which the tramway is located. For instance, the cost of maintaining the permanent way of a tramroad in Cheapside, with a traffic of 750,000 tons per annum per yard of street width, must be greatly in excess of the maintenance cost at Highgate, where probably the burden borne by the road does not exceed 2000 tons per annum per yard of width; and unless comparative costs of maintenance are reduced to a standard unit, they are valueless.

Mr. **Colam**: The answer to that is, that the traffic is light, and it must of necessity be light at Highgate.

Mr. **Ellice-Clark**: I thought at Chicago they might have reduced the cost of maintenance to a standard unit, in the way I have mentioned.

Mr. **Colam**: Of course there are streets where there is very heavy traffic. At New York when we applied to lay 76 miles of road there was no opposition. A 10-ton roller goes over the track frequently.

Mr. **Laws**: I would rather take 10 tons in a roller than 10 tons on wheels.

Mr. **Ellice-Clark**: When estimates of the cost of future maintenance are being prepared, they should, in my judgment, be based, *inter alia,* upon the traffic burden—the road has to bear other than tramway traffic—compared with the actual cost of maintaining tramways in other streets. These figures should be reduced to the standard unit of 100,000 tons per annum per yard of street width. There would then be no doubt about the question of maintenance cost as there is now, when the traffic was described in the comparative and unsatisfactory words "light" or "heavy." I give no opinion on the question whether a 10-ton roller would do more injury to a tramroad than a given number of lighter vehicles, or less injury than 10 tons on four wheels, that is another factor in the question of maintenance; and there might also be enumerated the class of traffic, distinguishing what might be termed the railway van and omnibus traffic, in which heavy burdens are carried at a high rate of speed on narrow tyres, from the "lorry" traffic, in which heavy burdens are borne at a slow rate on broad tyres. These are all considerations to be borne in mind in determining the cost of tramway maintenance. The author has not said anything about the cost and difficulty of maintaining pitched streets, in which tramways are laid, by reason of the longitudinal joints—four in number on ordinary tracks, increased to six by the cable system. All those who have maintained tramwayed streets know that a rut in the road along each rail was inseparable from the present method of bringing the pitchers butt to the rails, forming as it did a longitudinal joint. Various attempts have been made to obviate this evil. Mr. Stoney and the speaker invented a system of chairs which came to the surface and formed irregular lengths to break joint with the paving, but other engagements had prevented their pushing the invention. It appears that the most serious difficulty of the longitudinal joint is materially increased by the present system of laying cable roads, and it would be well for the proprietors of that system to devote their attention to the question of breaking up the joint by sleepers coming to the surface or some other means.

Mr. **Laws**: There is also the life of the cable. Mr. Meade says: "The average life of a cable is said to be from twelve to eighteen months; and the cable at Highgate is expected to run the full average time." Is it not a fact that you have already put in one new cable?

Mr. **Colam**: It is certainly a fact after the first cable had been put in it was found there had been a few mistakes made in the construction of the tube. The cable got off the pulley and rubbed into the concrete at the side, and you can imagine what effect that would have on the life of the cable. As this was the first cable line constructed in Europe, it was thought the cable should not be allowed to run the full length of time; and we took it up, perhaps before there was any necessity to do so. The present cable has been in now for eight months, and we fully expect it to wear the average life of a cable.

Mr. **Laws**: I am reminded that you have not yet given us any definite information as to the cost per mile of working the Highgate tramway?

Mr. **Colam**: I cannot give you that, I provided Mr. Meade with it, but he tells me that he has forgotten it. The actual working expenses at Highgate amount to 65*l.* per week.

Mr. **Dunscombe**: How many miles do you run.

Mr. **Colam**: Two thousand.

Mr. **Laws**: If Mr. Meade would supply these facts, as an addendum to the paper, before it is printed, it will meet the views of the meeting. I have pleasure in proposing a vote of thanks to Mr. Meade for his interesting paper.

DANGEROUS STRUCTURES.

By SIDNEY G. GAMBLE, Assoc. M. Inst. C.E., Borough Surveyor, Grantham.

In the consideration of this subject, it will be well for its more thorough investigation to divide it into four headings, viz. natural decay, defective foundations, faulty construction of superstructure, and such buildings as are erected for temporary purposes. The causes affecting the stability of buildings may be taken under chemical agencies, removal of the subsoil water, mining and underground works, unequally yielding foundations, removal of lateral support, structural alterations, overloading, wind, fire, lightning, &c.

Before particularising the above classification, it will be well to consider the law bearing upon the subject, which, for the majority of the Members of this Association, will be found in the Towns Improvement Clauses Act 1847, 10 & 11 Vict., c. 34, sect. lxxv. to lxxviii. and sect. lxxxiii., and incorporated in the Public Health Act 1875, by sect. 160.

"If any building or wall, or anything affixed thereon, within the limits of the special Act, be deemed by the surveyor of the Commissioners to be in a ruinous state and dangerous to passengers or to the occupiers of the neighbouring buildings, such surveyor shall immediately cause a proper hoard or fence to be put up for the protection of passengers, and shall cause notice in writing to be given to the owner of such building or wall, if he be known and resident within the said limits, and shall also cause such notice to be put on the door or other conspicuous part of the said premises, or otherwise to be given to the occupier thereof, if any, requiring such owner or occupier forthwith to take down, secure, or repair such building, wall, or other thing, as the case shall require; and if such owner or occupier do not begin to repair, take down, or secure such building, wall, or other thing within the space of three days after any such notice has been so given or put up as aforesaid, and complete such repairs, or taking down, or securing, as speedily as the nature of the case will admit, the said surveyor may make complaint thereof before two justices, and it shall be lawful for such justices, to order the owner, or, in his default, the occupier (if any) of such building, wall, or other thing, to take down, rebuild, repair, or otherwise secure, to the satisfaction of such surveyor, the same, or such part thereof as appears to them to be in a dangerous state within a time to be fixed by such justices; and in case the same be not taken down, repaired, rebuilt, or otherwise secured within the time so limited, or if no owner or occupier can be found, on whom to serve such order, the Commissioners shall with all convenient speed cause all or so much of such building, wall, or other thing as shall be in a ruinous condition, and dangerous as aforesaid, to be taken down, repaired, rebuilt, or otherwise secured in such a manner as shall be requisite; and all the expenses of putting up such fence, and of taking down, repairing, rebuilding, or securing such building, wall, or other thing, shall be paid by the owner thereof."

Section lxxvi. gives power to levy the expenses by distress upon the owner, and sections lxxvii. and lxxviii. empower the Commissioners to sell or otherwise dispose of the buildings or land, for the purpose of repaying themselves the expense they have incurred in carrying out the Act.

For the districts of the City of London and the Metropolitan Board of Works, the Metropolitan Building Act 1855, and the Amendment Act 1878, must be consulted.

From the foregoing it will be seen that in carrying out the above sections of the Act, a very onerous and responsible duty is placed upon the surveyor, in which great care and tact must be exercised, as apparently the opinion of the surveyor is conclusive in the matter.

Returning to the above headings, natural decay is that most common, as the continual action of the carbonic anhydride in the atmosphere, and the alternate contraction and expansion by frost and thaw, gradually but surely (though in differing degrees according to the nature or quality of the material), cause that continual waste which is going on over the whole surface of the land. Against this action the only remedy is renewal.

Defective foundations bring many otherwise noble buildings into the dangerous class: the use of timber below ground, removal of the subsoil water in the construction of sewers, removal of props in mining, building upon the site of ancient and long-forgotten excavations, or upon an equally unyielding foundation such as rock stepped out. In a rock foundation, unless extraordinary precautions are used in the selection of the materials, and in the elimination of all unequal settlement from a great number of mortar joints in any one portion of the walling than in another on the same level, any great weight in the building would crush the wall between the two unyielding forces, which would not be the case if the foundation was of a partially yielding nature, such as stiff clay or gravel.* Nothing leads to more disastrous results than the use of bad bricks and odd stones in the work below ground, for it should be remembered that the lower the portion of the wall the greater is the weight to be carried.

In instances of defective foundations the superstructure must be supported by raking, flying, or needle shores, while the underpinning is carefully carried out.

Chimneys, from their exposed position and height, compared with the size of the base, are constantly coming under the surveyor's wing; in dealing with this class of structure, including towers and spires, the vibration caused by the wind and ringing of bells must not be taken as a sign of weakness. Mr. Cowper, in a paper contributed to the Proceedings of the Inst. C. E., on April 30th, 1844, said he had known a large square chimney to move $\frac{1}{8}$ inch at 16 feet from the ground, and some chimneys would rock as much as 4 inches and yet be safe.

Many successful attempts have been made to straighten chimneys the foundations of which have partly given way, and by the removal near the bottom of wedged-shaped portions from the side where no settlement had taken place, and by allowing the gravity of the mass in a lever-like fashion to pull over the opposite half to the perpendicular. At Bingley, near Bradford, a chimney over 150 feet high was brought back 4 feet 6 inches to its original state by the above-mentioned means.

Faulty construction, alas (as every surveyor too well knows, even in these days, when science and art is supposed to have such an influence upon the people), is frequently met with, being the offspring of the excessive desire of society to obtain that which is impossible at the price, and thus foster those creatures of the age the jerry builder and the money-lender, who, by their greed and avarice, care nothing for the lives of those whom they pretend to befriend; in buildings of this kind walls are often composed of badly burnt bricks containing much organic matter, and held together by little more than their own gravity, the mortar generally used as the adhesive material being poor in quality and scarce in substance; the timber used in the construction is often of a flimsy kind and insecurely fixed. Such buildings as these are continually coming under the official examination of the surveyor, through the action of most of the causes mentioned in the early part of this paper, but more particularly through the removal of lateral support and fire.

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* Transactions R.I.B.A., February 1873.

Buildings of greater importance than those above alluded to may be considered to come under this heading, more particularly erections with ashlar casing and rubble backing. The memorable fall of the tower and spire of Chichester Cathedral, in February 1871, the immense chimney-shaft, 240 feet high, at the Newland Mills, Bradford, on the 28th of December, 1882, may be cited as examples of disasters of this kind, while the judicious and timely restoration of the Cathedrals of Hereford, Salisbury, and Peterborough, and the parish churches of Grosmont in Monmouthshire, St. Mary, Stafford, and many others, demonstrate to us the value of timely repairs in preventing these ancient monuments from impending ruin. Many of these works owe their security to the judicious use of iron bands and flying buttresses.

Time will not allow the details of the shoring to be gone into, but in all this class of underpinning work the following should be borne in mind, that not more than from 4 to 5 feet of wall should be removed at one time; good, clean cement concrete should be used if possible, carefully and quietly deposited in the trench and well rammed. The new and old work should be well pinned with slates and grouted with liquid cement.

New cement possesses the property of expanding as it sets, consequently causing the new work to press against the underside of the old, but this expansion causes a corresponding loss of strength. Mr. Stock in his work on Shoring states that "the best ground lime concrete, mixed in the proportion of 1 to 6, will expand as much as $\frac{3}{8}$ inch to every foot in height, and will permanently retain that size." In the underpinning of a large storehouse at Chatham Dockyard, in 1834, the upper portion of the concrete was forced into the vacant space and up to the bottom of the wall by the use of a framework fitted with screws.

Shores should be near the top of the wall to obtain as much leverage as possible. Fir is the best wood for shores on account of the grain being generally straight, and it is usually kept in stock in long lengths. The length of flying shores is limited to about 33 feet, as fir above that length cannot easily be obtained. The timber should be sound, and as square in section as possible, truly fitted at the joints, and the shore well made, as there is always some defection in the timber and the possibility of unforeseen defects. The action of the wind or the removal of some support may cause an excessive cross strain, which, unless especially provided for, may cause a serious derangement of the work. A special foundation should always be provided for shoring, and the angle at which the sole-piece is placed carefully adjusted, sufficient room being left for the work of rebuilding to be carried on.

Care should be taken, in arranging the position of the shores, to well support the chimney breasts, piers, corbels, and any portion of a structure having extra weight.

Temporary structures require especial care in the construction, particularly those used for the reception of large numbers of people, such as stands, hustings, shows, &c. The general tendency being to make this class of structure of the flimsiest kind on account of the short time they are used, whereas nothing is more trying to the stability of an erection than a moving load of excited people, beating time with their feet or crushing forward. The consideration of the opposing forces, necessitates great care in order that in all cases a sufficient resisting power may be obtained to counteract any pressure likely to be brought into play.

The destructive effects of lightning have of late years been much reduced by the use of copper conductors, nevertheless instances have occurred within the last twelve months in the spires of Grantham and Sleaford churches. In the case of Grantham the actual damage done by the electric current was small; the spire being fitted with a small copper cord, but with a bad termination. It was decided to fix a solid tape conductor, and ladders were fixed for that purpose; upon close examination, however, the top, 16 feet (284 feet from the ground), was found to be in a very dangerous state, not only by the shock it had sustained, but by reason of the decay of the mortar. Through the dilatoriness of the authorities it fell to the unfortunate lot of the author of this paper to serve a notice to remove the dangerous portion, which was attended to forthwith.*

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* In the case of *Reg.* v. *Lee*, 4 Q.B.D. 75, it was held that the incumbent of a church was not the owner so as to render him liable in respect of its dangerous condition.

In the case of Sleaford the damage done was of a serious nature, a portion of the spire falling during Divine service; happily, no one was injured: the tower was damaged to such an extent that the rebuilding of the tower and spire became necessary. Had a conductor been fixed, and the suggestions made in the report by Mr. Kirk, the architect, in 1852, been carried out, doubtless the tower would at the present moment have been standing in its original condition.

The action of fire upon walls is usually of a very serious nature, causing many a fine stone building to come tumbling about the firemen's ears, and those Members of the Association having charge of the fire brigades well know the effect of fire upon the igneous and limestone rocks, and the danger incurred by throwing water upon red-hot substances. The fumes from furnaces in which only coke is burnt have a great disintegrating effect upon brickwork, the author having in his possession a brick, taken from the top of a chimney, eaten away 2½ inches out of the 4½ inches in thickness.

The time allowed for this paper prohibits mention being made of many points that bear upon the subject; nevertheless, the author hopes through his suggestions the result may be that the Members will take up this important division of their work, and that subsequent papers upon the details will render our successors better able to grapple with the many points in dangerous structures.

DISCUSSION.

Mr. **Eayrs**: I am sure we must all feel very much obliged to Mr. Gamble for the interesting paper which he has prepared and read. It deals with a question of considerable interest to every one in this room, as I suppose there is hardly any one present who has not had, at one time or another, to deal with dangerous structures. This is more particularly the case in towns where mining is extensively carried on, and those who reside in towns in the south of England really have no idea of the very great difficulties some of us in mining districts experience in carrying out the sections of the Act of Parliament relating to dangerous structures. I think any legislation which takes place for amending the Public Health Act should also embrace these clauses relating to dangerous structures, which require to be very carefully revised. Section

75, which is set out at length in Mr. Gamble's paper, should receive special consideration. In the first place, in order to make all subsequent proceedings legal, you must immediately cause a hoarding or fence to be erected around the dangerous building. This in many cases is a great hardship on the owner of the property; and although I admit that owners who are loth to spend money for necessary repairs should not receive more than ordinary consideration, still there are owners of property who are prepared to carry out any suggestion we may make, without erecting any hoarding and spending money on their behalf. In many cases I have spoken to persons, or sent them private information that I should be compelled to take action, and they have immediately carried out what I required to be done. I think the clause directing the erection of a hoarding should be altered so that you might give an owner notice first, and then, if he did not carry out your orders, or give an undertaking to do so, a hoarding should be erected, unless it was such an exceptional case that it was necessary to erect a hoarding at once for the protection of the public. A great many cases of this kind have come under my own observation, and I should like to mention one which came before the Court of Queen's Bench, on appeal from the magistrates' decision. The case was fought very bitterly, and the gentleman who represented the defendant took every objection he possibly could. He first took the objection that my appointment as surveyor to the Local Authority was not under seal; but that is a matter I need not go into here. His next objection was as to the form of notice to be given. It says in the section, "repair, take down, or secure, such wall, building, or thing." The point raised respecting this was, whether the notice should not stipulate whether the buildings should be repaired, taken down, or secured.. The contention was, that it was the duty of the surveyor to state in his notice which of these things he required to be done. Of course we contended that this was not necessary; but that the owner could please himself what he did, so long as he rendered the building safe. Another point was, as to the opinion of the surveyor being conclusive as to the dangerous state of the building. This is a very important point, and one on which I think Mr. Gamble has fallen into error. He says, "apparently the opinion of the surveyor is conclusive in the matter." In the case to which I am alluding the only evidence brought before the magistrates as to the state of the building was my own. Of course I was cross-examined at great length; and when the defendant's case came on, evidence was tendered to prove, or intended probably to prove, that the building was not dangerous, although gentlemen on the opposite side admitted to me that it was dangerous, after the case was over. The defendant, however, tendered a witness to give evidence on his behalf; but the magistrates held that the opinion of the surveyor was binding and conclusive, and that they could not admit evidence on the other side, if they were satisfied with the evidence of the surveyor; and if they were not satisfied with the evidence of the surveyor, they must inspect the building themselves and then give their decision. These points were stated for the opinion of the Court of Queen's Bench; (1) as to whether the notice should specify whether the building should be secured, repaired, or taken down, and the opinion of the Court was that the notice was good, and that it was not necessary to state which of these things required to be done; (2) as to the rejection of the defendant's evidence, the Court held that the magistrates were wrong in refusing to hear evidence on the other side, and sent the case back to the magistrates to be reheard. In the meantime the owner pulled down the building and rebuilt it, and the consequence was that the Local Authority had to pay all the costs. The paper deals with a subject which ought to be very carefully considered, especially with respect to any future legislation involving alteration of these particular clauses of the Public Health Act.

Mr. **Lobley**: I am quite in accord with what Mr. Eayrs has said respecting these clauses, and the difficulty of dealing with dangerous buildings in places where the ground is all undermined. The responsibility thrown upon the surveyor of a district which is honeycombed in this way is something of which surveyors in the south of England can have no conception. I could, at the present moment, reasonably order one hundred buildings in my district to be taken down. The responsibility of doing this, or of not doing it, is a very serious one. I experience the difficulties Mr. Eayrs has pointed out. In cases where the structures certainly look suspicious, I sometimes call the attention of the owners to them, and they do what is necessary. But we cannot move legally without first putting up a hoarding, which in some cases costs more than the repairs necessary to make the property perfectly safe. No doubt the framers of the Act of Parliament thought if a property was unsafe to the public, the first step was to have a proper hoarding erected round it. Nevertheless, there is a great deal in the section which might be improved. Here is a specimen of the circumlocution I had to go through a fortnight ago. The first step was to serve notice and put up a fence; and I have here a photograph of the premises, which I will pass round. The next step, after waiting until the three days had expired, was to take the case before the magistrates, and I always tell a defendant I am going to bring the case before the justices on a certain day, so as to give him an opportunity of being present. The justices then make an order, and that order has to be duly served; then, if this order be not attended to, a meeting of the local authority has to be held before the next step can be taken. Before I took the premises down, I had the photograph taken in case there should be any dispute. There is certainly a great deal of needless formality. After the magistrates' order has been made I think action might be taken, without having also to get the sanction of the local authority. I might also add that the justices' order might be granted without previously hoarding out, where in the opinion of the magistrates such a course was admissible.

Mr. J. MATTHEWS JONES: If there is to be an alteration of these sections, it will be very easy to make an improvement; for instance, with respect to the erection of a proper fence or hoarding. It is perfectly ridiculous, when you have a dangerous chimney 50 or 60 feet high, or that distance from a public highway, to place a hoarding or fence round it for the protection of foot passengers. Yet I have had to do that several times. I do not represent a town that is honeycombed, but a town that is overcombed, as it were, with dangerous buildings. We date our Earls from 875, and there must have been buildings then in existence, many of which have been kept up by patching and other means to preserve the antiquity of the city. I am very much obliged to Mr. Eayrs for correcting the author's statement as to the opinion of the surveyor apparently being final and conclusive. I should also like to get an expression of opinion from the Association as to what should be done when a clock-tower or any portion of a church or church property is dangerous. The author has not helped us out of that difficulty. I had under observation for several years a splendid specimen of Perpendicular architecture, St. John's Church tower, built with an outside casing of stone and inner portion of body of rubble. The casing was battered and decayed, and in April 1881, a part of this rubble inner wall, 4 or

5 feet in thickness, rushed outwards, and one-half of the tower totally collapsed. I could not take action by erecting a hoarding, because then I should have brought upon the Authority the responsibility of taking the building down themselves, and not being able to recover the cost, whilst the materials would not pay for the pulling down. I should have been glad, too, if the author had given some of us inexperienced people in this line some of the signs of danger, and thus have helped us to cope with the difficulties with which we have to contend. It has been stated by Mr. Lobley that he does not know how many degrees some buildings in his district are out of the perpendicular. Some of the buildings in my city defy all the laws of gravitation. There are chimneys which look more as if they were constructed of indiarubber than of bricks and mortar, and some of the old oak buildings seem to be so well framed and attached together that, although hanging as though about to fall, it would take "all the king's horses and all the king's men," not to put up these buildings again, but to pull them down. I trust, Mr. President, that one result of this discussion will be to help the Council to get an amendment of these particular clauses, more especially as to the power of the surveyor, and as to whether the owner can be compelled to pull down a building when the occupier refuses to go out. We had a very peculiar case of this kind about a month ago. The owner was served with a notice, and was perfectly willing to comply with its requirements, but the occupier obstinately refused to go out. I got the order of the justice, but I had to take the building down almost brick by brick, and left the occupier with his beds and everything else exposed to the public view. I believe he has tried to get out of the payment of rent whilst this process was going on, and he has entered an action against the Corporation for having taken down the building over his head, without his having had proper legal notice to quit. The Corporation has handed over this to the landlord, who has agreed to accept the responsibility.

Mr. **Fowler**: If the Towns Improvement Clauses Act and the Public Health Act were read together, I think you will find that the surveyor of a local authority has extraordinary power, and the corporation really have nothing to do with it. I have acted in this way in many towns, and I have always found it successful. Of course the Act states you shall take your complaint before two justices; but it does not even say that you should go to the bench. The order of two justices will be sufficient for an order to pull down a building, and I think the surveyor should state what he requires to be done. On the other hand, there is always a danger of a timid man condemning a structure when it is not unsafe. A young surveyor will see a building overhanging, and consider it necessarily dangerous; but if it does not overhang its total thickness, it does not always follow that it will fall down. Being out of the perpendicular is not conclusive proof of the insecurity of a building. Caerphilly Castle is an example. There, the tower, which was built about the 11th century, has been out of the perpendicular for many years. In Stockport I have at present a notice served to pull one building down, where the danger is to the inmates of the house. I did not like to fence it off, because it was not "dangerous to foot passengers." It will fall inwards, I have not the slightest doubt. I think when the Act is revised, we should seek to strengthen our position by giving an impetus to the persons who draw these Acts to take care to ensure things being made to work more smoothly. That is as to the past; now with regard to the future. Of course a very large number of plans come before a surveyor from time to time, and architects who are not strictly practical, do not always secure for the future a structure as a permanent work. Many of the churches of this country are built with large towers, or perhaps towers and spires, having foundations on uneven strata. Take, for instance, St. Chad's Church at Headingly, near Leeds, where the tower was banded into the main walls of the building. Now as the tower is perhaps ten times the weight of the other portion of the building, of course if there is any liability to settle it will be where the heaviest weight is. The tower has settled and broken the adjoining walls at this particular point. This is not an exceptional case, but had the builder considered the desirability of building a straight joint at that particular part, then if the tower had settled, it would not have been at all damaging to other parts of the structure. Every chimney settles after it is built, we well know, which should be borne in mind. The next point is, take for example two long raking walls. Many builders will put joists lengthways of the building, instead of tying one wall to the other with the joists. At Stockport this is frequently done, and I have had to take some buildings down—one belonging to the Corporation—solely because the joists were not tied with the wall.

Mr. McKie: I cannot resist the temptation to second the vote of thanks to be given to the author of this paper. I am always pleased to see the young ones come to the front, and show what they are made of; and Mr. Gamble has done his work admirably. If we may judge of the merits of a paper by the length of the discussion which it creates, this is an extraordinarily good one. I will say nothing more, but simply second the vote of thanks to Mr. S. Gamble for his excellent paper on "Dangerous Structures."

Mr. A. T. **Davis**: I should like to follow the remarks of Mr. Fowler, just to say, for my own part, that I do not feel inclined to accept his advice to young surveyors to state specifically in serving notices of dangerous structures what should be done to render them safe. In my opinion the notices should simply be to render the buildings safe. The other day I had a case where the chimney-pot had fallen during the night, and had carried with it a few bricks from the top course, and left other bricks loose and hanging over. My attention was called to the state of the chimney by a neighbouring tradesman, who had to pass and repass along a passage under this chimney, and who stated that he considered it dangerous. I went and looked at the chimney, and came to the conclusion that it was dangerous. I ascertained who the owner of the property was, and adopting Mr. Eayrs's idea, went and just gave him a friendly intimation that I considered the chimney dangerous, and that I should be obliged to serve him with a notice unless he rendered the brickwork safe. He asked what I required to be done, and I said simply take down the loose, dangerous bricks. I did not say that he must build it up again to the required height, it did not matter to me whether he built it up again or not; but simply that he should remove what was dangerous.

Mr. **Hall**: I have simply one remark to make with reference to Mr. Fowler's observation respecting the difficulty he experiences when he finds that the walls of a building are going to fall inwards. I think if the surveyor notifies that the house is unfit for human habitation, that would get over the difficulty.

Mr. **De Courcy Meade**: Mr. Fowler has mentioned a point that I was about to have called attention to, where a house is dangerous to the occupants only, but not to the people outside. I have had two cases of this kind, where, for certain reasons, the occupants would not leave, and I could not get them out of the houses. Counsel was of opinion that we could not legally turn them out, but eventually, after some difficulty, we induced them to leave. This is a matter which should receive attention, if this section of the

Public Health Act is amended, because it sometimes happens that people really will not leave the houses. I think it is a risky thing to give notice that a structure is dangerous, until you can take the necessary steps to put up a hoarding. If you do this, you must be prepared to incur the responsibility. The surveyor to a West London District was recently brought up and charged with manslaughter for an alleged neglect of duty in this respect, but he was not convicted.

Mr. **Comber**: Will Mr. Gamble tell us whom he served the notice upon with respect to the dangerous spire at Grantham? The Queen's Bench has held that the incumbent of a church is not the owner so as to render him liable in respect of its dangerous condition. I should like to know, therefore, upon whom Mr. Gamble served the notice. I have a case, not of an old building, but a new church. The spire is nearly finished, and I have stopped the work. The incumbent denies his liability; the trustees say they are not liable, and the building committee say the same. The tower is built on bad foundations; and I object to piling, as if they do so they will disturb the foundation, as the tower is built close to a river wall.

Mr. **Buckham**: In that particular part of the paper where Mr. Gamble says, "the vibration caused by wind and the ringing of bells must not be taken as a sign of weakness," I entirely disagree with him. It is true that the vibration of a tall structure is not to be taken as a sign of absolute danger, as it depends to what extent that vibration goes on. I submit that, in proportion as a tall structure vibrates, from wind or any other cause, to that extent it is dangerous; but it would not be likely to fall unless, as Mr. Fowler properly observes, it overhangs the thickness of the wall. I am on this point supported by the formula laid down by Professor Rankine. Then as to the invaluable properties of cement for underpinning, from its powers of expansion. I believe that property of cement for underpinning is very valuable, but cement does not necessarily expand; that I should like to be distinctly understood, because I can speak from actual experience. If used new, it will expand; but if you want to use cement so that it will not expand, it must be a little aged. If you do not want the cement to expand, take care to lay it out about an inch or two thick on a floor, and let it become cool before it is used. When I restored the Town Hall at Ipswich two or three years ago, I fixed some terra-cotta terminals to portions of the building. I filled the terminals with cement concrete, and secured them to the building, but nearly the whole of them cracked. I wrote to Messrs. Doulton about this, and upon investigation it was found that the cement we had used was too new, and that it had consequently expanded. We went to work again, and when old cement was used the terminals did not crack. With regard to giving an opinion on the dangerous nature of a structure, it is a difficult matter to express a positive opinion about, and it is only by experience and examination that you are able to come to a conclusion whether a building really is or is not safe. The fact of a building being out of the perpendicular certainly does not render it necessarily unsafe. All of you who have seen Dutch towns, and particularly in Rotterdam, and other places, will have seen many buildings in the main streets even very much out of perpendicular; but they go on year after year, and do not get any worse. It therefore does not follow, because a building is out of the perpendicular, that it is necessarily unsafe.

Mr. GAMBLE: In carrying out these sections of the Act, I have found you must bring private influence to bear as much as possible to get the work done. When issuing notice, I either deliver it myself or send a private note, in the hope that the matter will be attended to at once, and so avoid further trouble. With regard to the church spire at Grantham, I had to go up 280 feet to examine the condition of the building, and no one in the town (the man who did the work was a stranger) thought well to go up for the purpose of contradicting me, and being one of the sidesmen of the church, I was able to bring some private influence to bear upon the churchwardens. Mr. Jones asked what are the signs of a dangerous building. Alas! that is the very point we all want to get at. In any alterations to the Act that the Council may think well to suggest, I trust the 80th clause in the Metropolitan Building Act, giving power to remove inmates from structures certified to be dangerous, will be strongly pressed. I should have said that the notice at Grantham, respecting the unsafe condition of the church spire, was served upon the vicar and churchwardens. They did not know of the case of *Reg.* v. *Lee*, which I put as a footnote in the paper that it might not be forgotten.

The vote of thanks to Mr. Gamble was then adopted.

ANNUAL MEETING IN LONDON, 1885.

RECEPTION BY THE LORD MAYOR.

On the Friday the Members were received and entertained at the Mansion House by Alderman Fowler, M.P., Lord Mayor. At the luncheon, his Lordship, supported by Alderman Sir Robert Carden, warmly welcomed the Association to the City of London, and referred to the important duties that devolved upon the Members in carrying out the many works in connection with the development of their respective towns, which tended so materially to the great improvement in sanitation, the consequent reduction of the death rate, and in the comfort and well-being of the inhabitants. Briefly alluding to the progress that can now be recorded, his Lordship pointed out the wide field, both in this country and abroad, that yet remains untouched by the labours of those who take interest in sanitary science, and hoped that this Association might be the means of still doing good work in this great cause; he sympathised with its object and wished it every success. The President, Mr. Vawser, in responding on behalf of the Association, spoke of the gradual growth of the official recognition evinced by the receptions accorded to the Association by Corporations of the various towns that were visited, and thanked the Lord Mayor for the welcome accorded to the Association on behalf of the City of London. The health of the Lord Mayor was proposed by Mr. Laws, Past-President, and briefly responded to.

The Members then visited and were conducted through the Holborn Subways—designed by Mr. Haywood, the Engineer to the Commissioners of Sewers—the Central Markets and the Highgate Steep Grade Tramway. On Thursday the Members dined together at the Criterion Restaurant, Piccadilly, on which occasion "Success to the Association" was proposed by Sir Robert Rawlinson, and the Mayor of Leicester responded to the toast of the "Municipal Institutions of the Country." On Saturday the

Members visited the works in progress of the widening of Blackfriars Bridge, after which they inspected the New Bridge at Putney, in course of construction; here they were received by Sir Joseph Bazalgette and Mr. Bazalgette, who carefully explained all the details of the work and the methods of construction. The Members were here entertained to luncheon and afterwards visited the Inventions Exhibition.

ON THE WASTEFULNESS OF IGNORANCE AND THE ECONOMY OF SCIENCE.

By EDWIN CHADWICK, C.B.

It is now evident that nothing systematic in the reform of general or of local administration is to be expected from the present Parliament, and that we must look entirely to the next Parliament, which will be largely composed of men who are in a state of ignorance as to the functions which they have to exercise. For them it will be important to convey instruction as to the wastefulness of ignorance, and of the executive initiative of ignorant, unpaid, and irresponsible service; and to maintain as a principle the superior economy of qualified, skilled, paid, and responsible service.

Thus, the administration of the Poors Rates, before the passing of the Poor Law Amendment Act, throughout 16,600 parishes, was chiefly administered by as many unpaid and irresponsible overseers. Up to the time of the passing of that Act,—including labour rates and many charges not brought to account,—the charge of that unpaid administration had been above 10*s.* per head of the population. By the change effected under that Act (which Mr. Gladstone referred to as being in his view, the greatest measure of this century), the administration was in great part charged upon 17,800 paid officers, the rates have been brought down to 6*s.* 8*d.* per head of the population.

But I have maintained, that by a restoration of the principles of the original measure, by the executive initiative of a paid, skilled, and responsible service, by confining the unpaid and irresponsible service to the exercise of supervisory service, like that of the visiting magistrates to the administration of the peace, a reduction of the expenditure by at least one-third may be effected, and the rates further reduced to some 4*s.* per head of the population.

By the paid services of the Members of the Association important reductions of death rates and consequent economies have been effected, with as yet imperfect functions. But the present charge of preventible disease chiefly upon the wage classes is proved to be three times heavier than the Poors Rates, or upwards of 24,000,000*l.* per annum; and that this charge will be reducible chiefly by the improvement of the functions, by increased securities for qualifications, and by extensions of administrative areas for the application of sanitary service. This, I believe, I have demonstrated at length in a recently published work, 'On Unity of Administration,' in which I show that the service of a paid police force is an economy as compared with the service of the old unpaid parish constable.

I venture to suggest to the Members of this Association, that they should each individually, in the interest of the public as well as themselves, exert themselves in giving instructions to the movers of either political party in the wastefulness of ignorance, and the superior economy of sanitary science, applied by well-qualified and competent and responsible paid service. The Association of Sanitary Inspectors, over which I have the honour to preside, have adopted a resolution to this effect, and I submit that it would be worthy of the co-operation of the Members of your Association, each in his own locality. And I hope that each Member of every other association of paid officers, of whatsoever political party, engaged in local administration, will for the improvement of his service and for the sake of the public, adopt the same course against the wastefulness of ignorance. Efficient paid service, it was shown by Sir J. Paget, goes to an economy of the cost of preventible sickness and mortality of upwards of 24,000,000*l.* annually, or three times the amount of the Poor Rates.

Memoirs of Deceased Members.

The Council, having been requested to append some short notice of the decease of Members of this Association, will feel obliged by early notice being forwarded to the Secretary, with such particulars as it may be desirable to insert in these 'Proceedings.'

It is with much regret that the Council have to chronicle the death of the late Secretary to the Association, Mr. Charles Henry Graham Smith (Graham Smith). The following, extracted by permission from the Minutes of Proceedings Inst. C.E., vol. lxxviii., gives an account of Mr. Smith's professional career. He was born in London on the 23rd May, 1851. Shortly afterwards his parents visited Australia, and his education was commenced at the collegiate school of the Rev. G. Macarthur, Macquarie Fields, New South Wales. Returning to England in 1864, he was placed at King's College School, where he remained till October 1866, when he was articled for three years to Messrs. Neilson and Co., of Glasgow. There he acquired a thorough practical knowledge of mechanical engineering, and at the same time continued his studies by the aid of masters in the evenings, working both in the shops and class-rooms with that earnestness which was one of his distinguishing characteristics. He then spent six months under Mr. John Fowler, Past President Inst. C.E., in studying the construction of the Metropolitan District Railway. In 1870 he was further articled for two years to Mr. George Fosbery Lyster, M. Inst. C.E., Engineer-in-chief to the Mersey Dock and Harbour Board, and had varied experience in the construction of dock and other engineering works, buildings, sewers, and the maintenance of roads. From May to November 1872 he was employed on the contractor's staff of the Isle of Man Railways during their construction; and in the preparation of the Parliamentary deposits of the Gloucester and Ledbury, and the Nettle Bridge Valley lines of the

Great Western Railway Company. After this, till October 1873, he assisted in Mr. Fowler's office in the preparation of the designs for the disposal of sewage at Malta, the Egyptian irrigation, and other extensive works. He next became assistant to Messrs. Blyth and Cunningham, MM. Inst. C.E., under whom he was engaged on designs for extensive works on the Caledonian Railway during the Carlisle Citadel Station improvements, and the Central Station works at Glasgow. He left this situation, in August 1874, to become Resident Engineer under Mr. Lyster during the restoration of the Liverpool floating landing stages and bridges, which had been destroyed by fire, and on the construction of the south reserve floating landing stage and piers at Birkenhead; and in 1877 he was occupied on designs and parliamentary work for the Liverpool Overhead Railway. At the end of this year he removed to Westminster, and commenced private practice, which he continued to the close of 1881; meanwhile for eighteen months of this period he acted as Secretary to the Association of Municipal Engineers. Having obtained the appointment of Engineer to the Port Commissioners of Rangoon, British Burmah, he proceeded thither, and besides general routine maintenance work, he erected several screw-pile jetties, with floating pontoon bridges, and reclaimed a large quantity of land. The Government also borrowed his services for a time to inspect and to advise on the improvement of the Moulmein river. Unfortunately, however, some differences having arisen between the Port Commissioners and himself, in which many of his professional friends considered he had been unjustly treated, and the anxiety of his position, in addition to the effects of the climate, having broken down his health, he resigned the appointment and returned to England in May 1883. In May 1884 he was employed by Messrs. John Fowler and Co. to proceed to San Francisco. He returned in July, and was making arrangements for a permanent residence in that country, when he was stricken down by his last illness, and he died of abscess on the liver on the 9th of September, 1884.

Mr. Graham Smith was admitted a Student of the Institution on the 5th of April, 1870; and while attached to that class was successful in obtaining two Miller Prizes; on the first occasion, for a Paper on "Practical Ironwork," and on the second, for a communication on "The Design and Construction of the South Reserve Piers and Floating Landing Stage at Birkenhead." * He

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* Minutes of Proceedings, Inst. C.E., vol. i., 1877, p. 164.

was elected an Associate of the Institution on the 6th of March, 1877, and was afterwards transferred to the class of Associate Members. Besides the communications for which he received the Miller Prizes, he was the author of several works on engineering subjects which were published, also of some addresses which met with a favourable reception. He was the founder of the Liverpool Engineering Society, of which he was President in 1876 and 1877, and afterwards Honorary Life Member. Mr. Graham Smith was clever, well-informed, and very persevering. He had an intense love for his profession, and was always most earnest and conscientious in the performance of everything that he undertook; while his uprightness and integrity, his gentleness of manner, and kindness of heart, obtained for him the respect and love of all his friends.

The remaining deaths are Mr. L. Dewey, the Surveyor to the Local Board of Cheshunt, who died in November 1884, and Mr. J. H. Pidcock, the Borough Surveyor of Northampton, which occurred in April 1885.

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PROCEEDINGS

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